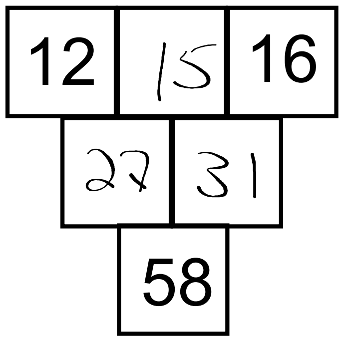
Challenge Problem!

Complete the pyramid of numbers so that each number is the sum of the two numbers above it



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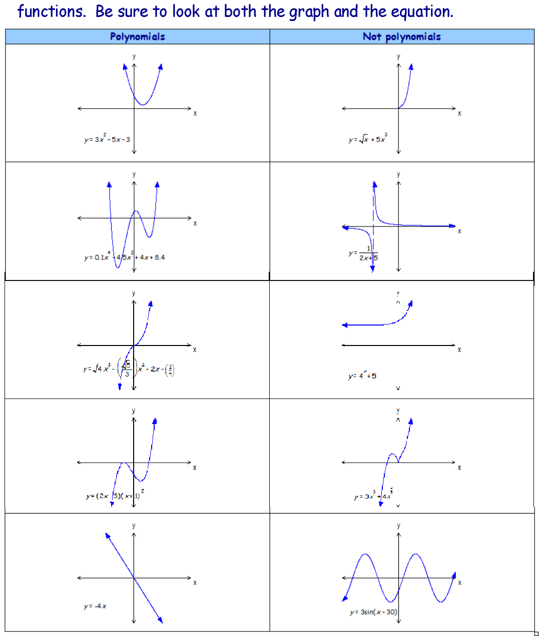
MHF4U - Unit 1: Polynomial & Rational Functions - Part I

1.1 Polynomial Expressions & Functions

explore

In groups, look at the given graphs and identify properties of polynomial functions. Be sure to look at both the graph and the equation.



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Characteristics of Unrestricted Polynomial Functions:

- Domain is the set of all real numbers. – no vertical asymptotes – no holes – no jumps
- Range with either: all real numbers or may have an upper OR lower bound not both
- There are NO asymptotes, no Trig, no roots, no fractional exponents

Equations of polynomial functions:

Constant $y = a$ = degree 0

Linear: $y = mx + b$ or $Ax + By + C = 0$ ⇒ degree 1

Quadratic: $y = ax^2 + bx + c$ ⇒ degree 2

Cubic: $y = ax^3 + bx^2 + cx + d$ ⇒ degree 3

Quartic : $y = ax^4 + bx^3 + cx^2 + dx + e$ ⇒ degree 4

Quintic : $y = ax^5 + bx^4 + cx^3 + dx^2 + ex + f$ ⇒ degree 5

Note : in each case, $a \neq 0$

Why?

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General equation of a polynomial function:

$$y = a_n x^n + a_{n-1}x^{n-1} + \dots + a_2x^2 + a_1x + a_0$$

leading coefficient coefficients constant term

- The degree of a polynomial is the value of the highest exponent
- A polynomial in standard form has descending powers of x.

Finite Differences

Recall:

→ 1st differences are constant for a linear function

→ 2nd differences are constant for a quadratic function

Ex. 1 Determine the finite differences for $y = x^3 - 2x^2 + 1$.

x	y	1st	2nd	3rd
0	1			
1	0	-1		
2	1	1	2	
3	10	9	8	6
4	33	23	14	6
5	76	43	20	6

This cubic function has constant third differences.

The n^{th} finite differences of a polynomial function of degree n are constant.

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Finite differences can be used to determine if a function is a polynomial, its degree and its equation.

Let's generalize:

Linear function: $y = ax + b$

x	y	1st
0	b	
1	$a+b$	a
2	$2a+b$	a
3	$3a+b$	a
4	$4a+b$	a

Slope!

$\therefore$ the value of the first difference is the slope of the line and you have the y-intercept in your TOV!

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Quadratic function: $y = ax^2 + bx + c$

x	y	1st	2nd
0	c		
1	$a+b+c$	$a+b$	
2	$4a+2b+c$	$3a+b$	$2a$
3	$9a+3b+c$	$5a+b$	$2a$
4	$16a+4b+c$	$7a+b$	$2a$

What patterns do you see?

- 2nd diff is $2a$

ex. $y=3x^2+4x-3$

2nd diff is 6

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Ex. 2 Determine the polynomial equation that models the following relationship.

x	y
0	-2
1	-1
2	-6
3	-17
4	-34

1ST DIFF: 1, -5, -11, -17

2ND DIFF: -6, -6, -6

Since 2ND DIFF is constant ∴ Quadratic

∴ $2a = -6$

$a = -3$

y-int $f(0) = -2$ ∴ $c = -2$

$y = -3x^2 + bx + c$

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

Sub in $(1, -1)$

$-1 = -3 + b - 2$

$b = 4$

$\therefore\ y = -3x^2 + 4x - 2$

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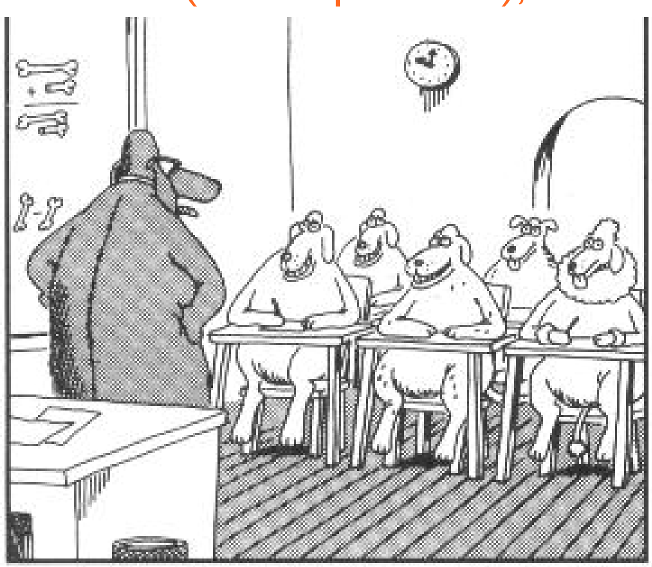
Homework
Page 127 #1, 2,
3bd (find equations), 4



"Well, here we go again. ... Did anyone here *not* eat his or her homework on the way to school?"

Sep 7-9:03 AM