Chapter 9
POWERS & NON-LINEAR FUNCTIONS

9-1 Powers & Exponents

4^5 ← exponent (how many times the base is multiplied)

↑ base (what gets multiplied)

$4^5 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 1{,}024$

$4^4 = 4 \cdot 4 \cdot 4 \cdot 4 = 256$

$4^3 = 4 \cdot 4 \cdot 4 = 64$

$4^2 = 4 \cdot 4 = 16$

$4^1 = 4 = 4$

} Repeated Multiplication

$4^0 = !\bigstar! = 1$ ★

$4^{-1} = \frac{1}{4} = \frac{1}{4}$

$4^{-2} = \frac{1}{4 \cdot 4} = \frac{1}{16}$

$4^{-3} = \frac{1}{4 \cdot 4 \cdot 4} = \frac{1}{64}$

} Repeated Division

★ This can be shown by using the "Quotient of Powers" rule.

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9-2 Prime Factorizations

A Prime number has exactly 2 factors, 1 and itself. Example: $11 = 1 \times 11$

2 3 5 7
11 13 17 19
23 29
31 37
41 43 47
53 59
61 67
71 73 79
83 89
97

- 2 is the only even prime number
- Watch out for the "3 rule": The sum of the digits is divisible by three
  ie: 432 adds up to 9
  $432/3 = 144$
- $13 \cdot 7 = 91$

Factoring numbers:

$60 = 2 \cdot 2 \cdot 3 \cdot 5$ or $2^2 \cdot 3 \cdot 5$

$450 = 2 \cdot 3 \cdot 3 \cdot 5 \cdot 5$ or $2 \cdot 3^2 \cdot 5^2$

Adding variables:

$20p^2 = 2 \cdot 2 \cdot 5 \cdot p \cdot p$

$56x^2t^3 = 2 \cdot 2 \cdot 2 \cdot 7 \cdot x \cdot x \cdot t \cdot t \cdot t$

9-3 Multiplying + Dividing Monomials

A monomial is an expression that contains only one term!

Examples: 48

$28x^3$

No addition or subtraction

$4^2 \cdot 4^4$ so... $= 4^6$

$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$

Examples: $3^3 \cdot 3^5 = 3^8$

$r \cdot r^4 = r^5$

$$\frac{5^4}{5^2} = \frac{5 \cdot 5 \cdot 5 \cdot 5}{5 \cdot 5} = 5^2$$

$$\frac{3^3x^2}{3x} = \frac{3 \cdot 3 \cdot 3 \cdot x \cdot x}{3x} = 3^2x$$

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9-4 Negative Exponents

(Repeated division)

$6^{-2} = \frac{1}{6 \cdot 6} = \frac{1}{36}$

$2^{-4} = \frac{1}{2 \cdot 2 \cdot 2 \cdot 2} = \frac{1}{16}$

$5^{-2} = \frac{1}{5 \cdot 5} = \frac{1}{25}$

$7^{-1} = \frac{1}{7}$

* Remember that any number to the zero power = 1

(Try it with the calculator)

$12^0 = 1$

$8^0 = 1$

Don't forget variables!

$q^{-4} = \frac{1}{q^4}$

$t^{-1} = \frac{1}{t}$