Mat 011 Agenda  Day 22: 03/12/03

- Return Test #2
- Negative Exponents, Scientific Notation, S183  
  PowerPoint Lecture 22
- Properties of Exponents, S191  PowerPoint Lecture 23
- Quiz on numerical exponential expressions

Homework:  **Topic 20, 21, page S187, S195**
\[ W = 0.25S + 15,000 \]

\[ 35,000 < W < 50,000 \]

\[ 35,000 < 0.25S + 15,000 < 50,000 \]

\[ -15,000 \quad -15,000 \quad -15,000 \]

\[ 20,000 < 0.25S \quad < 35,000 \]

\[ \frac{20,000}{0.25} \quad \frac{35,000}{0.25} \]

\[ 80,000 < S \quad < 140,000 \]
\[ C_S = 70 \quad C_R = 0.25m + 36 \]

\[ C_S = C_R \]

\[ 70 = 0.25m + 36 \]
\[ -36 \]
\[ 34 = 0.25m \]
\[ \frac{34}{0.25} \]
\[ 136 \text{ minutes} = m \]
\[ C_R = 25(100) + 36 = 61 \]

\[ \text{min} \begin{bmatrix} 25 \ 34 \ 0 \ 61 \ 100 \end{bmatrix} \]

\[ m = 25, \frac{34}{61} \]

\[ 136, 70 \]

\[ \begin{bmatrix} m = 0 \end{bmatrix} \]

\[ w = (0, x) \]

\[ \text{slope} \]

\[ \frac{70 - 36}{136 - 0} = \frac{34}{136} \]

\[ = 0.25 \]
Find the monthly payments on a 48-month car loan of $18,000 at 3% annual interest.

\[
P = A \left[ \frac{i}{1 - (1+i)^{-n}} \right]
\]

\[
i = \frac{.03}{12} = .0025
\]

\[
n = 48
\]

\[
P = 18,000 \left[ \frac{.0025}{1 -.8870} \right] = 18,000 \left[ \frac{.0025}{.113} \right] = 18,000 \left[ .02212 \right] = 398.23
\]
Scientific Notation

A number in Scientific Notation has the form \( P \times 10^n \) where \( 1 \leq P < 10 \) and \( n \) is an integer.

\[ 8,200,000 = 8.2 \times 10^6 \]
Scientific Notation

A number in Scientific Notation has the form \( P \times 10^n \) where \( 1 \leq P < 10 \) and \( n \) is an integer.

\[
8,200,000 = 8.20 \times 10^6
\]
Scientific Notation

A number in Scientific Notation has the form \( P \times 10^n \) where \( 1 \leq P < 10 \) and \( n \) is an integer.

\[ .000517 = \]

\[ 5.17 \times 10^{-4} \]
Scientific Form to Decimal Form
A number in Scientific Notation has the form $P \times 10^n$ where $1 \leq P < 10$ and $n$ is an integer.

$7.3 \times 10^6$

$7,300,000$

$7,300,000$
Scientific Form to Decimal Form

A number in Scientific Notation has the form $P \times 10^n$ where $1 \leq P < 10$ and $n$ is an integer.

$3.141 \times 10^{-4}$
Scientific Notation

A number in Scientific Notation has the form $P \times 10^n$ where $1 \leq P < 10$ and $n$ is an integer.

$.000517 = $
<table>
<thead>
<tr>
<th>Scientific</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8.14 \times 10^3$</td>
<td>8140</td>
</tr>
<tr>
<td>$4.18 \times 10^{-4}$</td>
<td>0.000418</td>
</tr>
<tr>
<td>$7.86 \times 10^8$</td>
<td>7860000000</td>
</tr>
<tr>
<td>$8.673 \times 10^{-10}$</td>
<td>0.00000000008673</td>
</tr>
<tr>
<td>$3.3 \times 10^{-2}$</td>
<td>0.033</td>
</tr>
<tr>
<td>Decimal</td>
<td>Scientific</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>0.0028</td>
<td>2.8 \times 10^{-3}</td>
</tr>
<tr>
<td>78,000</td>
<td>7.8 \times 10^4</td>
</tr>
<tr>
<td>0.00000167</td>
<td>1.67 \times 10^{-6}</td>
</tr>
<tr>
<td>0.000635</td>
<td>6.35 \times 10^{-4}</td>
</tr>
<tr>
<td>1,160,000</td>
<td>1.16 \times 10^6</td>
</tr>
<tr>
<td>Given</td>
<td>Changed Format</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>.0028 =</td>
<td></td>
</tr>
<tr>
<td>82000 =</td>
<td></td>
</tr>
<tr>
<td>8.14 x 10^3 =</td>
<td></td>
</tr>
<tr>
<td>4.18 x 10^{-4} =</td>
<td></td>
</tr>
</tbody>
</table>
\[-4.6^4 = -447.74\]
\[(4.6)^4 = 447.74\]
\[4.6^{-4} = .0022\]
Use calculator to evaluate: 

$$(6.3 \times 10^8)(4.2 \times 10^9)$$

To multiply a number in scientific notation use the EE key, 5th row, 2nd column.

$$2.646 \times 10^{18}$$
Use calculator to evaluate:

\[(6.3 \times 10^8)(4.2 \times 10^9)\]

To multiply a number in scientific notation use the **EE** key, 5th row, 2nd column.

\[(6.3 \times 10^8)(4.2 \times 10^9)\] is keyed in as 6.3, EE, 8, x, 4.2, EE, 9, Enter.
Objectives

- To learn how to multiply and divide expressions with exponents
- To learn how to raise expressions to a power
- To learn how to apply the properties of exponents
Multiplication

\[ a^n \times a^m = a^{n+m} \]

When you multiply, add the exponents as long as the bases are the same.
$2^5 \times 2^3$
$x^5 \times x^3$
Multiplication

\[ a^n \times a^m = a^{n+m} \]

When you multiply, add the exponents as long as the bases are the same.

\[ 2^5 \times 2^3 = 2^{5+3} = 2^8 \]

\[ (2 \times 2 \times 2 \times 2 \times 2)(2 \times 2 \times 2) = 2^8 \]
Multiplication

\[ a^n \times a^m = a^{n+m} \]

When you multiply, add the exponents as long as the bases are the same.

\[ 2^5 \times 2^3 = 2^{5+3} = 2^8 \]

\[ (2 \times 2 \times 2 \times 2 \times 2)(2 \times 2 \times 2) = 2^8 \]

\[ x^5 \times x^3 = x^{5+3} = x^8 \]
Raise an Expression to a Power
\((a^n)^m = a^{n \times m}\)
Raise an Expression to a Power

\((a^n)^m = a^{n\times m}\)

When you raise an expression to a power, multiply the exponents.
\[(2^5)^3 = \]
\[(2^5)^2 = \]
\[(x^3)^2 = \]
\[(3x^2)^4 = \]
Raise an Expression to a Power

\[(a^n)^m = a^{n\times m}\]

When you raise an expression to a power, multiply the exponents.

\[(2^5)^3 = 2^{5\times3} = 2^{15}\]

\[(2^5)^3 = (2^5)(2^5)(2^5) = 2^{5+5+5} = 2^{15}\]

\[(x^3)^2 = x^{3\times2} = x^6\]

\[(3x^2)^4 = (3^1)^4(x^2)^4 = 3^{1\times4}x^{2\times4} = 3^4x^8\]
Division

\[ a^n / a^m = a^{n-m} \]

When you divide, subtract the exponents as long as the bases are the same.

\[
\frac{2^5}{2^3} = 2^{5-3} = 2^2
\]

\[
\frac{2^5}{2^3} = \frac{\cancel{2} * \cancel{2} * \cancel{2} * 2 * 2}{\cancel{2} * \cancel{2} * \cancel{2}} = 2 * 2 = 2^2
\]

\[
\frac{x^8}{x^3} = x^{8-3} = x^5
\]
Expression Raised to a Negative Power

\[ a^{-n} = \frac{1}{a^n} \]

When you raise an expression to a negative power, take the reciprocal of the expression.
$8x^{-3} = (2x)^{-4}$
\[
\frac{1}{(4x^{-3})^2} = \frac{1}{(7x^2)^{-3}}
\]
(2x)^{-4}
\frac{1}{(4x^{-3})}
\[(2x)^{-4}\]
$8x^{-3}$
1/(7x^2)^{-3}
\[\frac{1}{4x^{-3}}\]
\[\frac{1}{(7x^2)^{-3}}\]
<table>
<thead>
<tr>
<th>Expression</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3x^2x^3$</td>
<td></td>
</tr>
<tr>
<td>$4(-3x^2)^2$</td>
<td></td>
</tr>
<tr>
<td>$6x(-2x^2)^3$</td>
<td></td>
</tr>
<tr>
<td>Expression</td>
<td>Evaluation</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>( \frac{8x^5}{x^{-3}} )</td>
<td></td>
</tr>
<tr>
<td>( \frac{4x^{-3}}{8x^{-1}} )</td>
<td></td>
</tr>
<tr>
<td>( \left( \frac{-2}{x^2} \right)^3 )</td>
<td></td>
</tr>
</tbody>
</table>
The population of Shanghai was 10,820,000 in 1974. If the population increased by 1% each year, complete the table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Calculation</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td></td>
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</tr>
<tr>
<td>1977</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Compute the following using a calculator:

1. $8^{-3}$

2. $-8^{-3}$

3. $(-8)^{-3}$

4. $(3.8\times10^5)(6.2\times10^7)$
5. $8x^5 x^3$

6. $(8x^3)^2$

7. $\left( \frac{x^4}{2} \right)^{-3}$
8. Use the formula $P = A \left[ \frac{i}{1 - (1+i)^{-n}} \right]$

- $P$ is the payment
- $A$ is the amount of the loan
- $n$ is the number of payments
- $i$ is the interest rate per month

TJ Ridge is borrowing $15,000 to buy a car. He takes out a 36-month loan at 6% annual interest. (Hint: $i = 0.06/12$). Find Tom’s monthly payments.
9. Given \( FV = P(1 + i)^n \), find the future value of $1500 deposit if the annual rate is 8% compounded monthly for 20 years. (Hint \( i = \frac{0.08}{12} \) and \( n = 12 \times 20 \))