**Math 140  Lecture 11**

**Exponential functions**

**DEFINITION.** An exponential function is of the form $y=b^x$ with the base $b>0$.

- $b^0 = 1$, $b^1 = b$, $b^2 = b \cdot b$, ...
- $b^{-n} = 1/b^n$
- $b^{1/n}$, the $n^{th}$ root of $b$
- $b^{p/q} = b^{p(1/q)} = (b^{1/q})^p$

**Examples**

<table>
<thead>
<tr>
<th>Exponent Rules</th>
<th>Simplify to an integer or a single exponent $b^n$.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(b^m)^n = b^{mn}$</td>
<td>$(5^2)^3 = (5^2)(5^2)(5^2) = 5^6$</td>
</tr>
<tr>
<td>$b^n b^m = b^{n+m}$</td>
<td>$5^2 5^3 = (5 \cdot 5)(5 \cdot 5 \cdot 5) = 5^5$</td>
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<tr>
<td>$b^m/b^n = b^{m-n}$</td>
<td>$5^3/5^4 = 1/5$, $5^7/5^3 = 5^4$</td>
</tr>
<tr>
<td>$(ab)^n = a^n b^n$</td>
<td>$2^5 3^5 = 6^5$</td>
</tr>
<tr>
<td>$(a/b)^n = a^n/b^n$</td>
<td>$(2/3)^5 = 2^5/3^5$</td>
</tr>
</tbody>
</table>

**True or false?**

- $e \approx 2.7$  **Fact:** $e \approx 2.7$  **True** since $e^2 \approx 2.7^2 < 3^2 = 9$
- $\sqrt{e} < 1$  **False** since $\sqrt{e} \approx \sqrt{2.7} > 1$