# Mathematics 11U

## 4.2 – Working With Integer Exponents

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## Laws of Exponents: (when bases are the same)

### 1. Product Rule (multiplying)

$$4^3 \times 4^2 = (4 \times 4 \times 4) \times (4 \times 4) = 4^5$$

$$a^m \times a^n = a^{m+n}$$

Law: When multiplying with the same base, add the exponents.

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2. Quotient Rule (dividing)

$$\frac{5^6}{5^2} = \frac{5\times5\times5\times5\times5\times5}{5\times5} = 5^4$$

$$\frac{a^m}{a^n} = a^{m-n}$$

Law: When dividing with the same base, subtract the exponents.

## Laws of Exponents: (when bases are the same)

### 3. Power Law

$$(3^2)^4 = (3\times 3)\times(3\times 3)\times(3\times 3)\times(3\times 3) = 3^8$$

$$(a^m)^n = a^{mn}$$

Law: When raising the ~~a~~ base to a power, multiply the exponents.

## Laws of Exponents: (when bases are the same)

### 4. Zero Law

$7^2 = 1 \times 7 \times 7$

$7^0 = 1$

$\frac{7^2}{7^2} = \frac{49}{49} = 1$ $\quad$ $\frac{7^2}{7^2} = 7^{2-2} = 7^0 = 1$

$(2000^{1001})^0 = 1$

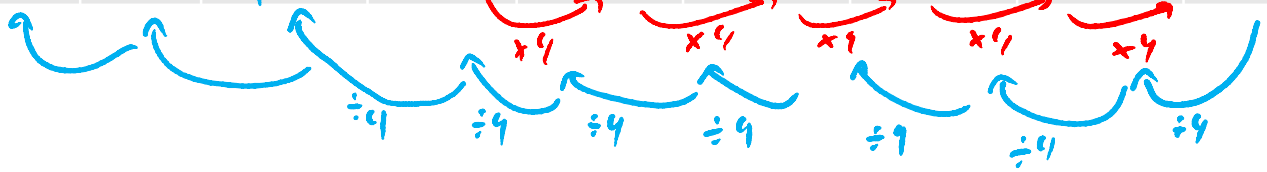
Law: Anything raised to the power of zero is equal to one.

# Laws of Exponents: (when bases are the same)

## 5. Negative Exponent Law

Law: A negative exponent means the reciprocal.

| Exponent | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| Base | $4^{-3}$ | $4^{-2}$ | $4^{-1}$ | $4^{0}$ | $4^{1}$ | $4^{2}$ | $4^{3}$ | $4^{4}$ | $4^{5}$ |
| Result | $\frac{1}{64}$ | $\frac{1}{16}$ | $\frac{1}{4}$ | 1 | 4 | 16 | 64 | 256 | 1024 |




$$4^{-4} = \frac{1}{4^4} = \frac{1}{256} \qquad \frac{1}{4^{-2}} = 4^2 = 16 \qquad \frac{3^{-3}}{4^{-2}} = \frac{4^2}{3^3} = \frac{16}{27}$$

## Examples: Simplify, then evaluate.

$$\frac{(2^3)(2^4)}{2^2} = \frac{2^7}{2^2} = 2^5 = 32$$

$$\frac{(3^{-1})^2}{3^{-3}} = \frac{3^{-2}}{3^{-3}} = 3^{-2-(-3)} = 3^1 = 3$$

$$\left[\frac{(4^6)(4^3)}{(4^2)(4^7)}\right]^{-2} = \left[\frac{4^9}{4^9}\right]^{-2} = (4^0)^{-2} = 4^0 = 1$$