Math 4b.

Properties of exponent:

1. If the same base raised to the different power and then multiplied:

$4^3 \cdot 4^5 = (4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4 \cdot 4 \cdot 4) = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 4^8 = 4^{3+5}$

Or in a more general way:

$$a^n \cdot a^m = \underbrace{a \cdot a \ldots \cdot a}_{n\ times} \cdot \underbrace{a \cdot a \ldots \cdot a}_{m\ times} = \underbrace{a \cdot a \cdot a \ldots \cdot a}_{n+m\ times} = a^{n+m}$$

2. If the base raised to the power of *n* then raised again to the power of *m*:

$$(4^3)^5 = (4^3) \cdot (4^3) \cdot (4^3) \cdot (4^3) \cdot (4^3) =$$

$$= (4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4) = 4^{3 \cdot 5}$$

Or in a more general way:

$$(a^n)^m = \underbrace{a^n \cdot a^n \cdot \ldots \cdot a^n}_{m\ times} = \underbrace{\underbrace{a \cdot a \cdot \ldots \cdot a}_{n\ times} \cdot \ldots \cdot \underbrace{a \cdot a \cdot \ldots \cdot a}_{n\ times}}_{m\ times} = a^{n \cdot m}$$

3. If there are two numbers *a* and *b*:

$$(a \cdot b)^n = \underbrace{(a \cdot b) \cdot \ldots \cdot (a \cdot b)}_{n\ times} = \underbrace{a \cdot \ldots \cdot a}_{n\ times} \cdot \underbrace{b \cdot \ldots \cdot b}_{n\ times} = a^n \cdot b^n \qquad (9)$$

- $a^n = \underbrace{a \cdot a \cdot a \ldots \cdot a}_{n\ times}$
- $a^n \cdot a^m = a^{n+m}$
- $(a^n)^m = a^{n \cdot m}$
- $(a \cdot b)^n = a^n \cdot b^n$

Homework

1. Write the following expressions in a shorter way:

Example: $7 \cdot 7 \cdot 7 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 = 7^3 \cdot 8^4 \cdot 9^5$

a. $2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 7 \cdot 7 =$

b. $\underbrace{3 \cdot 3 \cdot \ldots \cdot 3}_{6\ times} \cdot \underbrace{5 \cdot 5 \cdot \ldots \cdot 5}_{6\ times} =$

c. $\underbrace{(-4) \cdot (-4) \cdot \ldots \cdot (-4)}_{5\ times} \cdot \underbrace{6 \cdot 6 \cdot \ldots \cdot 6}_{4\ times} =$

2. Represent as a fraction:

Examples: $3^{-2} = \frac{1}{3^2} = \frac{1}{9}; \qquad 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

a. 4^{-2} *b.* 3^{-3} *c.* 2^{-5} *d.* 5^{-2}

3. Evaluate:

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

a. 2^3 *b.* 4^2 *c.* $\left(\frac{1}{2}\right)^3$ *d.* 0.1^2

4. What should be x equal to in the following equations:

a. $2^x = 8$ *b.* $x^2 = 4$

5. Evaluate:

Example: $2^3 \cdot 2^2 = 2^{2+3} = 2^5 = 32$

$5^2 \cdot 5^1 =$ $\qquad$ $(2^3)^2 =$

$2^2 \cdot 2^2 \cdot 2^1 =$ $\qquad$ $(n^5)^3 =$

6. True or false?

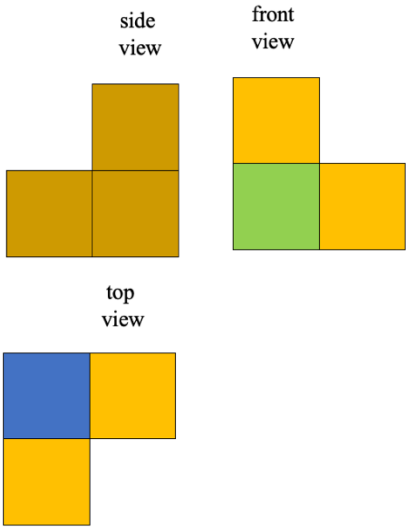
a. $3^4 \cdot 3^2 = 3^8$ *b.* $(3^2)^3 = 3^6$ *c.* $3^{-2} = \frac{1}{3^{-2}}$

7. Calculate and write down the first five powers of 2 and the first five powers of 3. (Do not use calculator.)

8. On a graph paper below draw **top, side and front views** of a figure (use different colors)

Example:

figure



figure