

## Algebra 2 (basic) ~ 2.2 Properties of Exponents (ret)

Goal: evaluate and simplify expressions with exponents & apply

◆ **Skill A** Evaluating numerical expressions with exponents

**Recall** You can associate a negative exponent with a reciprocal.

◆ **Example 1**

Without using a calculator, evaluate each expression.

a.  $4^3$     b.  $4^0$     c.  $4^{-1}$     d.  $4^{-3}$     e.  $4^{\frac{1}{4}}$     f.  $4^{\frac{3}{2}}$

◆ **Solution**

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

b.  $4^0 = 1$

*For any nonzero number a,  $a^0 = 1$ .*

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

*A negative exponent indicates a reciprocal.*

Notice that the result is not negative.

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

e.  $4^{\frac{1}{2}} = \sqrt{4} = 2$

$a^{\frac{1}{n}} = \sqrt[n]{a}$

f.  $4^{\frac{3}{2}} = (\sqrt{4})^3 = 2^3 = 8$

$a^{\frac{m}{n}} = (\sqrt[n]{a})^m$

◆ **Example 2**

Express each number as a power of 3.

a. 81    b. 1    c.  $9^3$     d.  $\frac{1}{27}$     e.  $\sqrt{3}$     f.  $\sqrt{27}$

◆ **Solution**

a.  $81 = 3^4$

b.  $1 = 3^0$

c.  $9^3 = (3^2)^3 = 3^6$

d.  $\frac{1}{27} = \frac{1}{3^3} = 3^{-3}$

e.  $\sqrt{3} = 3^{\frac{1}{2}}$

f.  $\sqrt{27} = \sqrt{3^3} = 3^{\frac{3}{2}}$

**Evaluate each expression.**

1.  $5^2$  \_\_\_\_\_

2.  $2^5$  \_\_\_\_\_

3.  $6x^0$  \_\_\_\_\_

4.  $(6x)^0$  \_\_\_\_\_

5.  $(2 \cdot 3)^2$  \_\_\_\_\_

6.  $3^0 \cdot 3^3 \cdot 3$  \_\_\_\_\_

7.  $2^{-1}$  \_\_\_\_\_

8.  $2^{-3}$  \_\_\_\_\_

9.  $\left(\frac{2}{3}\right)^2$  \_\_\_\_\_

10.  $\left(\frac{2}{3}\right)^{-1}$  \_\_\_\_\_

11.  $\left(\frac{2}{3}\right)^{-2}$  \_\_\_\_\_

12.  $\left(\frac{1}{5}\right)^2$  \_\_\_\_\_

13.  $\left(-\frac{1}{5}\right)^2$  \_\_\_\_\_

14.  $16^{\frac{1}{4}}$  \_\_\_\_\_

15.  $16^{\frac{3}{2}}$  \_\_\_\_\_

16.  $27^{\frac{2}{3}}$  \_\_\_\_\_

17.  $49^{\frac{3}{6}}$  \_\_\_\_\_

18.  $9^{-\frac{3}{2}}$  \_\_\_\_\_

**Express each number as a power of 2, if possible.**

19. 32 \_\_\_\_\_

20. 1 \_\_\_\_\_

21.  $4^5$  \_\_\_\_\_

22.  $\frac{1}{2}$  \_\_\_\_\_

23.  $\frac{1}{8}$  \_\_\_\_\_

24.  $\sqrt{32}$  \_\_\_\_\_

25.  $\sqrt[3]{2}$  \_\_\_\_\_

26.  $-\frac{1}{16}$  \_\_\_\_\_

27. 0 \_\_\_\_\_

28.  $8^{\frac{2}{3}}$  \_\_\_\_\_

## Algebra 2 (basic) ~ 2.2 Properties of Exponents (ret)

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### ◆ Skill B Simplifying algebraic expressions involving exponents

**Recall** When you simplify an algebraic expression involving exponents, use Properties of Exponents.

#### ◆ Example 1

Simplify  $\left(\frac{-x^5}{2x^{-3}y^4}\right)^4$ . Write your answer using positive exponents only.

#### ◆ Solution

$$\begin{aligned} \left(\frac{-x^5}{2x^{-3}y^4}\right)^4 &= \frac{(-x^5)^4}{(2x^{-3}y^4)^4} && \text{Power of a Quotient: } \left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \\ &= \frac{x^{20}}{16x^{-12}y^{16}} && \text{Power of a Power: } (a^m)^n = a^{mn} \\ &= \frac{x^{20-(-12)}}{16y^{16}} && \text{Quotient of Powers: } \frac{a^m}{a^n} = a^{m-n} \\ &= \frac{x^{32}}{16y^{16}} \end{aligned}$$

#### ◆ Example 2

Simplify  $5x\left(yx^{-\frac{3}{2}}\right)^{-2}$ . Write your answer using positive exponents only.

#### ◆ Solution

$$\begin{aligned} 5x\left(yx^{-\frac{3}{2}}\right)^{-2} &= 5x(y^{-2}x^3) && \text{Power of a Product: } (ab)^n = a^n b^n \\ &= 5x^4y^{-2} && \text{Power of Powers: } (a^m)^n = a^{mn} \\ &= \frac{5x^4}{y^2} && \text{Definition of negative exponent: } a^{-n} = \frac{1}{a^n} \end{aligned}$$

**Simplify each expression, assuming that no variable equals zero.**

**Write your answer using positive exponents only.**

29.  $a^2a^4a^3$

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30.  $x^3(5x)^2$

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31.  $(3x^2y)(xy^2)$

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32.  $(a^2b)(-3ab^3)(2ab)$

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33.  $(c^2d)^3(cd^3)^2$

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34.  $(2x^2y^3)^3(3x^3y^0)^2$

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35.  $\left(\frac{-z^3}{y^2}\right)^5$

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36.  $\left(\frac{4x^2y^{-3}}{y^{-2}}\right)^{-1}$

---

37.  $(x^{-5}y^{-1})^{-2}(x^2y^{-4})^3$

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38.  $\left(\frac{3x}{y^{-3}}\right)^3\left(\frac{5x^{-10}yz^2}{2x^{-1}y^3}\right)^{-2}$

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## SOLUTIONS

**1.** 25   **2.** 32   **3.** 6   **4.** 1   **5.** 36   **6.** 81

**7.**  $\frac{1}{2}$    **8.**  $\frac{1}{8}$    **9.**  $\frac{4}{9}$    **10.**  $\frac{3}{2}$    **11.**  $\frac{9}{4}$

**12.**  $-\frac{1}{25}$    **13.**  $\frac{1}{25}$    **14.** 4   **15.** 64   **16.** 9

**17.** 7   **18.**  $\frac{1}{27}$    **19.**  $2^5$    **20.**  $2^0$    **21.**  $2^{10}$

**22.**  $2^{-1}$    **23.**  $2^{-3}$    **24.**  $2^{\frac{5}{2}}$    **25.**  $2^{\frac{1}{3}}$

**26.**  $-2^{-4}$    **27.** not possible   **28.**  $2^2$    **29.**  $a^9$

**30.**  $25x^5$    **31.**  $3x^3y^3$    **32.**  $-6a^4b^5$    **33.**  $c^8d^9$

**34.**  $72x^{12}y^9$    **35.**  $-\frac{z^{15}}{y^{10}}$    **36.**  $\frac{y}{4x^2}$    **37.**  $\frac{x^{16}}{y^{10}}$

**38.**  $\frac{108x^{21}y^{13}}{25z^4}$