# Negative and Zero Exponents

Adapted from Principles of Mathematics 10, McGraw-Hill Ryerson, 2007.

Show your work beside each one. Your Summary has the ideas from today's discussion.

**1.** Find the value. Give each answer as a whole number or a fraction in lowest terms.

a) $15^0$ b) $12^{-1}$ c) $10^{-1}$ d) $(-4)^{-2}$

e) $\left(\frac{1}{5}\right)^{-2}$ f) $\left(\frac{1}{4}\right)^{-1}$ g) $4^{-1} + 4^{-2}$

**2.** Write each one with positive exponents only. Use the exponent laws first where there are two powers. Do not find the value.

a) $7^{-5}$ b) $m^{-4}$ c) $6^{-3}$

d) $\left(\frac{1}{9}\right)^{-2}$ e) $3^4 \div 3^9$ f) $10^2 \times 10^{-6}$

**3.** Find the exponent that makes each statement true.

a) $2^{\square} = \frac{1}{128}$ b) $20^{\square} = 1$ c) $7^{\square} = \frac{1}{49}$ d) $\left(\frac{1}{2}\right)^{\square} = 16$

**4.** Show that $9^0 = 1$ in two ways.

a) Use a pattern. Start at $9^2 = 81$ and go down one exponent at a time.

b) Use the exponent law for dividing powers with the same base.

**5.** Each student made an error. Find the correct value. Then explain the error in one sentence.

a) Kai wrote $2^{-6} = -64$.

b) Lena wrote $11^0 = 0$.

c) Omar wrote $\left(\frac{1}{4}\right)^{-2} = \frac{1}{16}$.

d) Priya wrote $2^{-1} + 2^{-1} = 2^{-2}$.

**6.** Write these powers in order from least to greatest. Find the value of each one first.

$$5^{-2} \qquad 7^0 \qquad 2^{-5} \qquad \left(\frac{1}{3}\right)^{-1} \qquad 2^{-4}$$

**7.** A scientist keeps a sample of a substance in a lab. Each day, half of the sample breaks down, so its mass halves every day. Today the sample has a mass of 12 g. Let $t$ be the number of days from today, so $t = -1$ is yesterday and $t = 1$ is tomorrow.

| **Days from today, $t$** | $-3$ | $-2$ | $-1$ | $0$ | $1$ | $2$ | $3$ |
|---|---|---|---|---|---|---|---|
| **Mass (g)** | | | | 12 | | | |

a) Complete the table.

b) The mass is $M = 12 \times \left(\frac{1}{2}\right)^t$. Use this equation to find the mass when $t = -3$. Show that it matches your table.

c) How many days ago was the mass 384 g? Explain.

d) Use the equation to find the mass 5 days from today. Give it as a fraction of a gram.

# Negative and Zero Exponents — Hints

Stuck? Read the hint for that question, then go back and try again. Each hint points back to an idea from today's discussion. It does not give you the answer.

**Question 1**

Recall the tables of powers on Cards 1 and 2 (Questions 1 and 2 on the discussion page): what happens to the value each time the exponent goes down by 1. For a negative base or a fraction, recall Card 7 (Question 7 on the discussion page).

**Question 2**

Recall Card 4 (Question 4 on the discussion page), where cancelling showed what a negative exponent means. For e) and f), recall the exponent laws on the Get Ready for Quadratic Relations sheet from the first day of this unit.

**Question 3**

Recall the tables of powers on Cards 1 and 2 (Questions 1 and 2 on the discussion page). Which exponent gave the value 1? Which exponents gave fractions?

**Question 4**

Recall Card 1 (Question 1 on the discussion page) for the pattern, and Card 3 (Question 3 on the discussion page) for the exponent law. Those two cards did the same job for $2^0$.

**Question 5**

Recall Cards 5 and 6 (Questions 5 and 6 on the discussion page), and the two kinds of reasons we used to show Sam and Jordan why they were wrong. For d), find the value of each power first.

**Question 6**

Find the value of each power first, as on Card 7 (Question 7 on the discussion page).

**Question 7**

Recall Card 1 (Question 1 on the discussion page): what happens to the value each time the exponent goes up or down by 1. A negative $t$ is a time before today, and a positive $t$ is a time after today.