



Grade 6 Math Circles
Wednesday, March 3, 2021
Exponents - Problem Set

1. Evaluate.

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|------------------------------------|--------------|--------------|--------------|
| (a) 5^3 | (c) 2^6 | (e) 4^4 | (g) 13^2 |
| (b) $\left(\frac{101}{4}\right)^0$ | (d) 1^{27} | (f) 0^{56} | (h) ϕ^1 |

2. Write the following as powers. (*Hint: For part (c), try factoring the number*)

- | | |
|---------------------------------|--|
| (a) $333 \times 333 \times 333$ | (d) 5 to the fourth power |
| (b) 91 to exponent 5 | (e) 100 squared |
| (c) 216 | (f) $7 \times 11 \times 11 \times 7 \times 11 \times 7 \times 7$ |

3. Use the given base to write the following numbers as powers.

- | | |
|---------------------|--------------------|
| (a) 4096, base = 4 | (d) 512, base = 2 |
| (b) 625, base = 5 | (e) 289, base = 17 |
| (c) 1000, base = 10 | (f) 81, base = 3 |

4. Express 1 as a power that has a base not equal to 1.

5. Evaluate.

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|---------------|-----------------|-----------------------------------|---------------------------------------|
| (a) $(-30)^4$ | (c) 2^{-6} | (e) $(15)^{-3}$ | (g) $(-88)^0$ |
| (b) 47^{-1} | (d) $(-1)^{38}$ | (f) $\left(-\frac{7}{6}\right)^5$ | (h) $\left(-\frac{4}{25}\right)^{-2}$ |

6. Fill in the table summarizing different properties of exponents.

Property	Explanation	Example
Base of 1		
Base of 0		
Exponent of 1		
Exponent of 0		
Negative Exponent		
Negative Base		

7. Consider the fraction $\frac{16}{81}$.

(a) Write $\frac{16}{81}$ as a power with a negative base.

(b) Write the fraction as a power with a negative base and exponent.

8. Use exponent rules to simplify the following expressions. Note that part (g)-(h) are challenge questions.

(a) $\left(\frac{12}{7}\right)^2$	(c) $\frac{6^{38}}{6^6}$	(e) $\frac{4^{84}}{4^{83}}$	(g) $ab^2 \times bc^2 \times abc$
(b) $10^3 \times 10^7$	(d) $(13^{11})^2$	(f) $(9^7)^7$	(h) $(8u^5v^4)^{12}$

9. Fill in the blanks with $<$, $>$, or $=$ to complete the inequality.

(a) $2^4 \text{ ___ } 4^2$	(c) $99^0 \text{ ___ } 0^{45}$	(e) $7^{-3} \text{ ___ } 7^{-1}$
(b) $6^{-3} \text{ ___ } 6^3$	(d) $(-1)^{27} \text{ ___ } 1^{27}$	(f) $4^{-6} \text{ ___ } (-4)^{-7}$

10. The human brain has $\frac{(10^{15})(10^{31})}{(10^{23})^2}$ neuronal connections. Express this number as a single power.

11. According to the Big Bang Model, the universe has $\left(\frac{(5^{26})(5^9)}{5^{34}}\right)^{1450} \times (10^{11})^2$ stars. Simplify the expression.

12. Tom had three hamsters at the beginning of the year. After 4 weeks, he now has 243 hamsters. Assuming weekly exponential growth, how much is the population exponentially increasing by every week?

13. A bacteria population quadruples in size every 10 minutes. If the initial bacteria population is 7 specimens, what is the population after 1 hour?

14. Rio created a computer algorithm which can process an exponential amount of data and reduce processing time. For example, let x represent the initial amount of data the algorithm can process in one minute. Then, it can process x^2 amount of data in 2 minutes. Rio calculates that the algorithm is able to process 400 GB of data in 2 minutes. How long would it take to process 3,200,000 GB of data?

15. Magic Morning Coffee shares that 15% of the caffeine in their drink is consumed by the human body every hour. If a teacher had 1 cup of coffee, or 128 mg of caffeine, at 10 AM this morning, how much caffeine is left in their system at 5 PM?

16. The **half-life** of a substance is the amount of time it takes for the quantity of the substance to decrease to half its original value. For example, gallium-67 is a substance used in nuclear medicine with a half life of 80 hours. If a scientist has 288 grams of gallium-67 at the beginning of an experiment, and 72 grams at the end, how long was the experiment?