**Exponent Laws**

- $a^m \times a^n = a^{m+n}$ (multiplication law)
- $a^m \div a^n = a^{m-n}$ (division law)
- $\left(a^m\right)^n = a^{mn}$ (power law)
- $(ab)^m = a^m b^m$ (power of a product law)
- $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ (power of a quotient law)
- If $a \neq 0$, $a^0 = 1$ (zero exponent property)
- If $a \neq 0$, $a^{-m} = \frac{1}{a^m}$ and $\frac{1}{a^{-m}} = a^m$ (negative exponent property)
- $a^{\frac{1}{n}} = \sqrt[n]{a}$, where n is a natural number. If n is even, then a ≥ 0. If n is odd, then a can be any real number.
- $a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m = \sqrt[n]{a^m}$, where m and n are natural numbers.

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1. Evaluate the following, leave your answers in FRACTION form if possible. (4 marks)

   a) $5^{-2}$ b) $-5^2 + 5^0$ c) $2 \times \left(\frac{1}{3}\right)^2$ d) $((2^3)^2)^{-1}$

2. Simplify, leave your answers in EXPONENT form if possible. (4 marks)

   a) $a^5 \times a^2 \times a$ b) $\left(y^3\right)\left(y^{-6}\right)\left(y^0\right)$ c) $\left(n^2\right)^3$ d) $\left(\frac{4x^{-3}y^4}{8x^2y^{-2}}\right)^{-2}$

3. Simplify. Express each answer with **positive** exponents. (8 marks)

   a) $\frac{-54t^3}{3t}$ b) $\left(\frac{a}{2b^2}\right)^{-3}$ c) $\frac{12x^5y^{-2}z^3}{3x^4y^2z^3}$ d) $(ab^3)^{-2}(a^6b)^3$

4. Write in simplified EXPONENT form (one exponent only, no radicals). (4 marks)

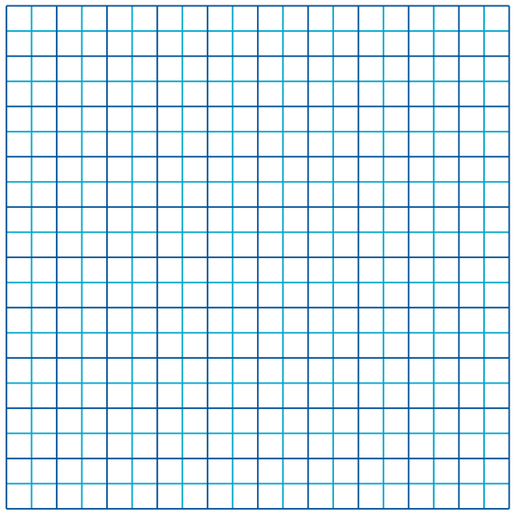
   a) $\sqrt[3]{7}$ b) $\sqrt[5]{a^{10}}$ c) $[\sqrt[3]{m}\,]^8$

5. Evaluate exactly (leave your answers in FRACTION form if possible). (4 marks)

   a) $32^{\frac{3}{5}}$ b) $100\,000^{\frac{4}{5}}$ c) $81^{-\frac{1}{4}}$ d) $\left(-\frac{1}{8}\right)^{\frac{1}{3}}$

6. Sketch the following exponential functions on the grid below and state the y intercept, domain, range, and asymptote: (6 marks)

| | $f(x) = 3^x$ | $g(x) = \left(\frac{1}{2}\right)^x$ |
|---|---|---|
| y-intercept | | |
| Domain | | |
| Range | | |
| Asymptote equation | | |



7. The growth in population of a small town *since 1998* is given by the function P*(n)* = 1250(1.03)$^n$ where P represents the population and "n" represents the number years since 1998.

   a. What is the initial population? _____ , and what is the growth rate? _____

   b. Determine the population in 2016.

   c. In which **year** does the population reach 2500 people?

8. An ant colony grows by 12% in number every month. Currently, there are 30 000 in the nest. (6 marks)

   a) Write an equation that models the number of ants in the colony, given the number of months.

   b) Predict the size of the colony in three months.

9. A new car costs $24000 and loses 18% of its value each year after it is purchased.

   a) Write the equation that models the value of the car *n* years after it was purchased.

   b) How much of the car's initial value is lost after 5 years?

   c) What is the value of the car after 30 months?