

X¹ Exponent rules

None of this is on the CLT formula sheet, and there is no calculator: memorize it.

Operation	Rule	Example
Multiply, same base	add exponents	$a^2 \cdot a^3 = a^5$
Divide, same base	subtract	$\frac{a^6}{a^2} = a^4$
Power of a power	multiply	$(a^2)^3 = a^6$
Same exponent, multiply	multiply bases	$a^2 b^2 = (ab)^2$
Same exponent, divide	divide bases	$\frac{a^3}{b^3} = \left(\frac{a}{b}\right)^3$
Zero power	equals 1	$a^0 = 1, a \neq 0$
Negative power	reciprocal	$a^{-2} = \frac{1}{a^2}$
Fractional power	denominator is the root	$a^{2/3} = \sqrt[3]{a^2} = (\sqrt[3]{a})^2$

- ✓ Simplify until no exponent is negative
- ✓ A negative base to an even power is positive; to an odd power, negative
- ✓ Tripling 4 three times: $4 \times 3^3 = 108$

Ratios and proportions

- ✓ A ratio is not two fixed numbers: 9 : 4 does not mean 9 people and 4 people
- ✓ You may use the ratio's numbers as one example, then scale
- ✓ Part of the whole: add the parts. 2 red : 7 blue makes red $\frac{2}{9}$ of the total
- ✓ Cross-multiply: $\frac{a}{b} = \frac{c}{d}$ becomes $ad = bc$
- ✓ Combine two ratios by matching the shared term

Quadratics

- ✓ Standard form: $ax^2 + bx + c = 0$; always set a quadratic equal to zero first
- ✓ Vertex and axis of symmetry: $x = -\frac{b}{2a}$
- ✓ Vertex form: $y = a(x - h)^2 + k$, vertex (h, k) ; $x - 3$ means $h = 3$
- ✓ $a < 0$ opens down (a maximum); the y -intercept is c
- ✓ Quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- ✓ Discriminant $b^2 - 4ac$:
 - greater than 0: two real solutions
 - equal to 0: one solution
 - less than 0: no real solutions
- ✓ Sum of the roots $-\frac{b}{a}$; product $\frac{c}{a}$

Factoring

- ✓ $x^2 + bx + c$: two numbers that multiply to c and add to b : $x^2 - 2x - 8 = (x - 4)(x + 2)$
- ✓ Take out a common factor first: $4n^2 + 16n + 12 = 4(n + 1)(n + 3)$
- ✓ Difference of squares: $a^2 - b^2 = (a - b)(a + b)$
- ✓ Perfect squares: $(a + b)^2 = a^2 + 2ab + b^2$; $(a - b)^2 = a^2 - 2ab + b^2$
- ✓ $(a + b)^2 \neq a^2 + b^2$: expand it
- ✓ No clean factors, or square roots in the answers? Use the quadratic formula