

Quadratics

- ✓ **Standard form** $y = ax^2 + bx + c$: opens up if $a > 0$, down if $a < 0$; c is the y -intercept
- ✓ **Vertex** (maximum or minimum): $x = -\frac{b}{2a}$
- ✓ **Vertex form** $y = a(x - h)^2 + k$: vertex (h, k) ; $(x - 3)^2$ means $h = 3$
- ✓ **Quadratic formula** $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- ✓ **Discriminant** $b^2 - 4ac$:
 - > 0 : two real solutions
 - $= 0$: one solution
 - < 0 : no real solutions
- ✓ Solutions' **sum** $= -\frac{b}{a}$; **product** $= \frac{c}{a}$
- ✓ **Set the equation equal to zero** before solving: always

Factoring

- ✓ $x^2 + bx + c$: find two numbers whose **product** is c and **sum** is b : $x^2 - 2x - 8 = (x - 4)(x + 2)$
- ✓ Signs of the middle and last terms:
 - $+$ and $+$: both factors positive
 - $-$ and $+$: both negative
 - $+$ and $-$ or $-$ and $-$: one of each; the larger matches the middle sign
- ✓ Take out a **common factor** first: $4x^2 + 16x + 12 = 4(x + 1)(x + 3)$
- ✓ **Difference of squares**: $a^2 - b^2 = (a - b)(a + b)$
- ✓ **Perfect squares**: $(a \pm b)^2 = a^2 \pm 2ab + b^2$, never $a^2 + b^2$

Polynomials

- ✓ In $ax^3 + bx^2 + cx + d$, the constant d is the y -intercept
- ✓ The x -intercepts are the zeros (roots): the x values that make it 0
- ✓ **Radical equations** such as $\sqrt{x + 5} = x - 1$ can produce an **extraneous** solution: check each answer

X¹ Exponent rules

Rule	Example
Multiply same bases: add exponents	$a^2 \cdot a^3 = a^5$
Divide same bases: subtract exponents	$a^6 \div a^2 = a^4$
Power of a power: multiply exponents	$(a^2)^3 = a^6$
Same exponent: combine the bases	$a^2b^2 = (ab)^2$, $\frac{a^3}{b^3} = (\frac{a}{b})^3$
Zero power, for $a \neq 0$	$a^0 = 1$
Negative: a reciprocal	$a^{-2} = \frac{1}{a^2}$
Fraction: the denominator is the root	$a^{\frac{2}{3}} = \sqrt[3]{a^2} = (\sqrt[3]{a})^2$

- ✓ **Like terms** share variables **and** powers: x^3 and $-9x^3$ combine; x^3 and x^2 don't
- ✓ A negative base to an **even** power is positive; to an **odd** power, negative

Exponential functions

- ✓ $y = ab^x$: a is the **starting amount** and the y -intercept, since $b^0 = 1$
- ✓ b is the **multiplier** per period: $b = 2$ doubles each period
- ✓ **Growth** if $b > 1$; **decay** if $0 < b < 1$
- ✓ **Growth rate** r : $b = 1 + r$; compound interest $A = P(1 + r)^t$
- ✓ $f(t) = 6,000(4)^{t/275}$: quadruples every **275** minutes

Functions and translations

- ✓ $f(x)$: x is the **input** (inside = input), $f(x)$ or y the **output**
- ✓ **Evaluate** $f(3)$: replace **every** x with 3; a point $(19, 0)$ on the graph means $f(19) = 0$

Change	Graph moves
$f(x) + k$	up k
$f(x) - k$	down k
$f(x + k)$	left k (opposite the sign)
$f(x - k)$	right k (opposite the sign)