ACT: Number Properties

Rules of Exponents

$$a^0 = 1$$
$$a^1 = a$$
$$a^{-m} = \frac{1}{a^m}$$

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$
$$a^{\frac{m}{n}} = \sqrt[n]{a^m}$$

$$a^m \cdot a^n = a^{m+n}$$
$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$
$$a^n b^n = (ab)^n$$
$$\frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$$

Logarithmic Properties

Definition of a Logarithm:

If $\log_a b = c$, then $a^c = b$.

Change of Base Rule:

$$\log_a b = \left(\frac{\log b}{\log a}\right)$$

Additional Properties:

$$\log_m(ab) = \log_m a + \log_m b$$
$$\log_m\left(\frac{a}{b}\right) = \log_m a - \log_m b$$
$$\log_m a^b = b \log_m a$$

Arithmetic and Geometric Series

Arithmetic Series:

$$\text{Common Difference}: d = a_{n+1} - a_n$$
$$\text{n}^{th}\text{term}: a_n = a_1 + (n-1)d$$
$$\text{Sum of the first n}^{th}\text{terms}: S_n = \frac{n}{2}(a_1 + a_n)$$

Geometric Series:

$$\text{Common Ratio}: r = \frac{a_{n+1}}{a_n}$$
$$\text{n}^{th}\text{term}: a_n = a_1 r^{n-1}$$
$$\text{Sum of the first n}^{th}\text{terms}: S_n = a_1\left(\frac{1-r^n}{1-r}\right)$$

Factoring Properties

Difference of Two Squares:

$$a^2 - b^2 = (a-b)(a+b)$$

Perfect Square Trinomial:

$$(a \pm b)^2 = a^2 \pm 2ab + b^2$$

Sum & Difference of Cubes:

$$a^3 \pm b^3 = (a \pm b)(a^2 \pm ab + b^2)$$

ACT: Additional Number Properties

Complex Numbers

Complex Number: $a + bi$

Value of i: $i = \sqrt{-1}$ $\quad i^2 = -1$

Additional Properties:

$$\sqrt{-n} = i\sqrt{n}$$
$$(a+bi)(a-bi) = a^2 + b^2$$

Value of i repeats every 4 terms:

$$i^0 = 1, i^4 = 1$$
$$i^1 = i, i^5 = i$$
$$i^2 = -1, i^6 = -1$$
$$i^3 = -i, i^7 = -i$$

Radical Properties

$$\sqrt[n]{a} = a^{\frac{1}{n}}$$
$$\sqrt[n]{ab} = \sqrt[n]{a}\sqrt[n]{b}$$
$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

Rationalization:

$$\frac{a}{\sqrt{b}} = \frac{a}{\sqrt{b}} \cdot \frac{\sqrt{b}}{\sqrt{b}} = \frac{a\sqrt{b}}{b}$$

Arithmetic Formulas

Sum of n Consecutive Integers: $\frac{n}{2}(a_1 + a_n)$ *where n = the total number of terms, a_1 = the first term, and a_n = the last term*

Sum of n Consecutive Odd Integers: $\frac{n}{2}(a + l)$ *where n = the total number of terms, a = the first term, and l equals the last term*

Sum of Natural Numbers (Sequence begins from 1): $\frac{n(n+1)}{2}$ *where n = the total number of terms*

Sum/Multiplication of Odd and Even Integers:

$$\text{Even} + \text{Even} = \text{Even} \qquad \text{Even} \times \text{Even} = \text{Even}$$
$$\text{Odd} + \text{Odd} = \text{Even} \qquad \text{Odd} \times \text{Odd} = \text{Odd}$$
$$\text{Odd} + \text{Even} = \text{Odd} \qquad \text{Odd} \times \text{Even} = \text{Odd}$$

Cross-multiplication:

$$\frac{a}{b} = \frac{c}{d} \Leftrightarrow ad = bc$$

ACT: Coordinate Geometry Properties

Intercepts

x-intercept:

x when $y = 0$
crosses the x-axis

y-intercept:

y when $x = 0$
crosses the y-axis

Distance of Points

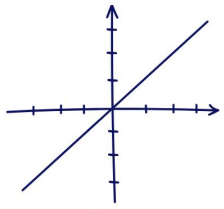
Distance:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Midpoint:

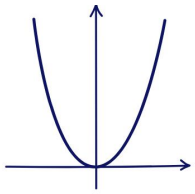
$$p = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Common Types of Graphs



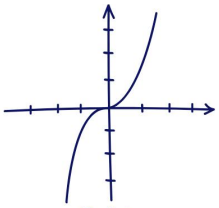
Linear

$y = ax + b$



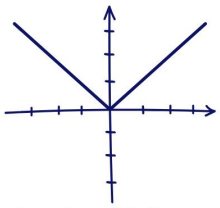
Quadratic

$y = ax^2 + bx + c$



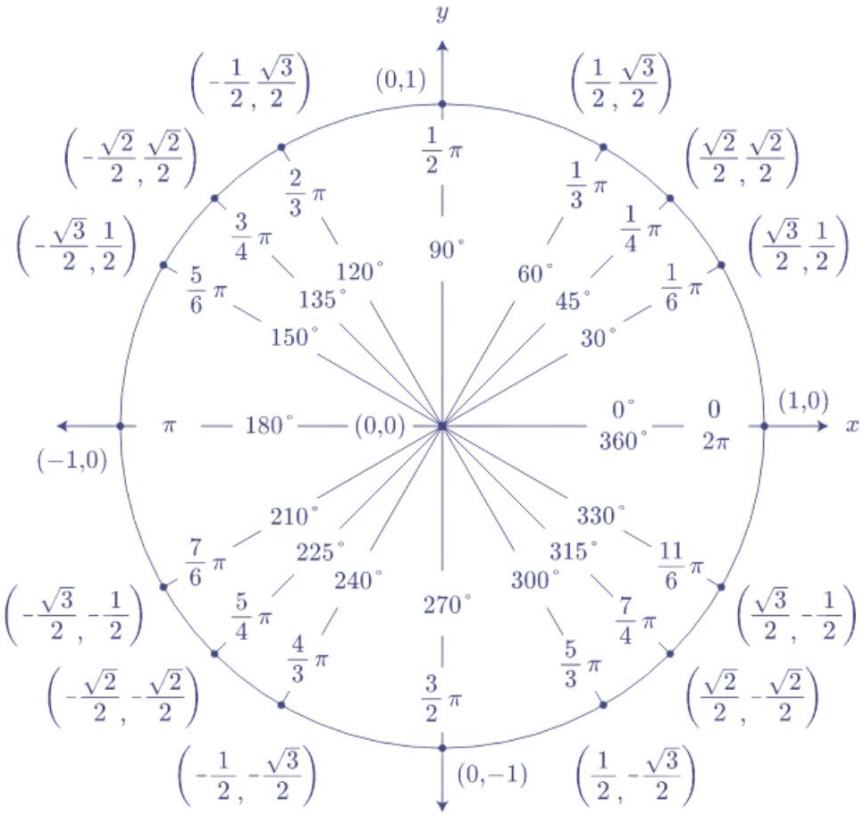
Cubic

$y = ax^3 + bx^2 + cx + d$



Absolute Value

$y = |x - h| + k$



Study Tip!

Assess your strengths and weaknesses in each ACT section (English, Math, Reading, Science, and optional Writing). Allocate more study time to areas where you need improvement.

Take multiple full-length practice tests under timed conditions to get a feel for the pacing and format of the ACT. Analyze your results to identify your strengths and weaknesses.

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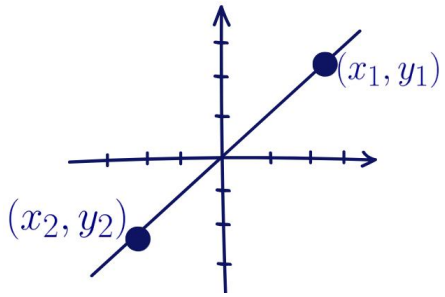
ACT: Linear and Quadratic Functions

Linear Functions



Finding the Slope:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope-Intercept Form:

$$y = mx + b$$
$$m : \text{slope}$$
$$b : \text{y-intercept}$$

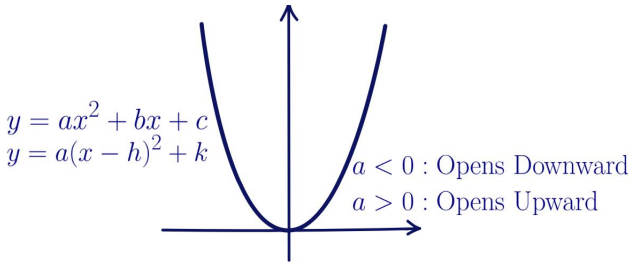
Point-Slope Formula:

$$(y - y_1) = m(x - x_1)$$
$$m : \text{slope}$$
$$(x_1, y_1) : \text{point}$$

Parallel & Perpendicular Lines:

$$\text{Parallel} : m_1 = m_2 \qquad \text{Perpendicular} : m_1 = -\frac{1}{m_2}$$

Quadratic Functions



Quadratic Formula:

$$\text{Given} : ax^2 + bx + c = 0$$
$$x = -\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Vertex Formula:

$$(h, k) = \left(-\frac{b}{2a}, \frac{4ac - b^2}{4a}\right)$$
$$= \left(-\frac{b}{2a}, f(h)\right)$$

Discriminant:

$$D = b^2 - 4ac$$

$D > 0$: 2 Real Solutions
$D = 0$: 1 Real Solution
$D < 0$: 2 Imaginary Solutions

ACT: Statistics and Probability

Percentage

Percent, Part, and Whole:

$$\text{Part} = \frac{\text{Percent}}{100} \times \text{Whole}$$

$$\text{Whole} = \text{Part} \div \frac{\text{Part}}{100}$$

$$\text{Percent} = \frac{\text{Part}}{\text{Whole}} \times 100\%$$

Counting Techniques

Permutation: order doesn't matter

$$P = \frac{n!}{(n-r)!}$$

Combination: order matters

$$C = \frac{n!}{r(n-r)!}$$

Statistics (Mean, Mode, and Median)

Mean:

$$\text{Mean} = \frac{\text{Sum of Terms}}{\text{Number of Terms}}$$

Mode:

Most frequent number to appear.

Range:

Max Value − Min Value

Median:

Central number when list is arranged from least to greatest.

Probability

$$\text{Probability} = \frac{\text{Desired Outcomes}}{\text{Total Number of Outcomes}}$$

$$P(\text{event happens}) + P(\text{event doesn't happen}) = 1$$

$$P(A \text{ and } B) = P(A) \times P(B)$$

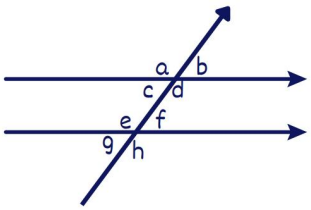
ACT: Angles and Triangles

Angles and Lines

Complementary : $\angle a + \angle b = 90^\circ$

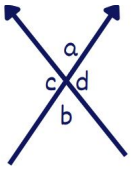
Supplementary : $\angle a + \angle b = 180^\circ$

Parallel Lines:



$$a = d = e = h$$
$$b = c = f = g$$
$$c + e = 180^\circ, d + f = 180^\circ$$

Intersecting Lines:



$$a = b, c = d$$
$$a + c = 180^\circ$$
$$b + d = 180^\circ$$

Triangles

Sum of Angles:

$$\angle a + \angle b + \angle c = 180^\circ$$

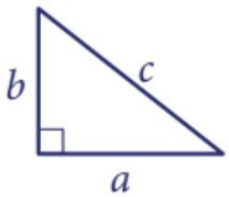
Area:

$$A = \frac{1}{2}bh$$

Perimeter:

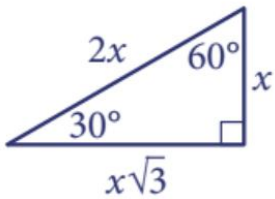
$$P = s_1 + s_2 + s_3$$

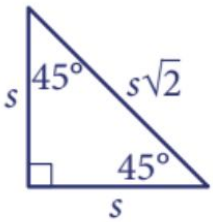
Pythagorean Theorem:



$$c^2 = a^2 + b^2$$

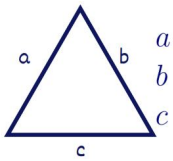
Special Right Angles





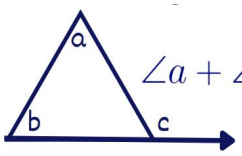
Triangle Properties

Triangle Inequality:



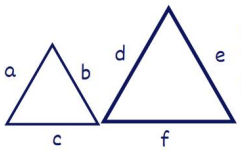
$$a < b + c, a > |b - c|$$
$$b < a + c, b > |a - c|$$
$$c < a + b, c > |a - b|$$

Exterior Angle Theorem:



$$\angle a + \angle b = \angle c$$

Similar Triangles:

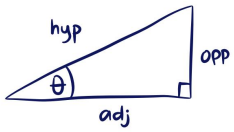


$$\frac{a}{d} = \frac{b}{e} = \frac{c}{f}$$

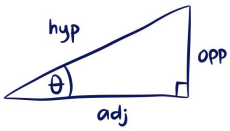
ACT: Polygons and Trigonometry

Trigonometry

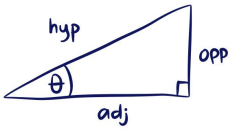
Mnemonic: SOH CAH TOA



$\sin(\theta) = \frac{opp}{hyp}$



$\cos(\theta) = \frac{adj}{hyp}$



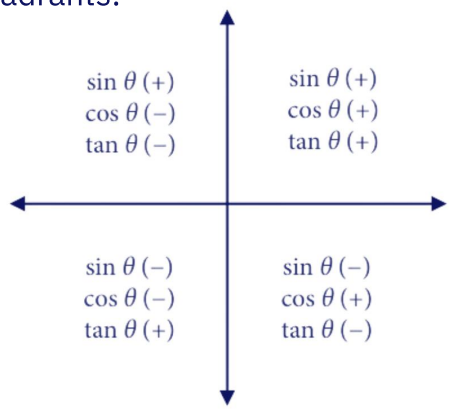
$\tan(\theta) = \frac{opp}{adj}$

Cofunctions:

$$\sin(90 - x) = \cos x$$
$$\cos(90 - x) = \sin x$$
$$\sec(90 - x) = \csc x$$
$$\csc(90 - x) = \sec x$$
$$\tan(90 - x) = \cot x$$
$$\cot(90 - x) = \tan x$$

Additional Properties

Signs in Quadrants:

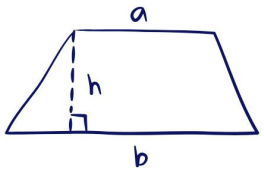


Additional Properties:

$$\csc\theta = \frac{1}{\sin\theta}$$
$$\sec\theta = \frac{1}{\cos\theta}$$
$$\cot\theta = \frac{1}{\tan\theta}$$
$$\sin^2\theta + \cos^2\theta = 1$$

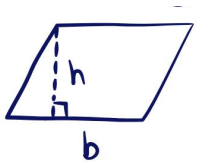
Polygons

Area of Trapezoid:



$A = \frac{a+b}{2}h$

Area of Parallelogram:



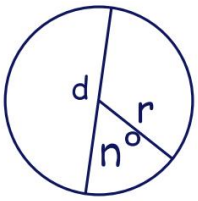
$A = bh$

Sum of Angles:

$$\text{Interior Angles} : (n-2)(180^\circ)$$
$$\text{Exterior Angles} : 360^\circ$$

ACT: Circles, Volume, and Surface Area

Circles and Properties



Circumference & Area:

$$\text{Circumference} = 2\pi r = \pi d$$
$$\text{Area} = \pi r^2$$

Arc Length & Sector:

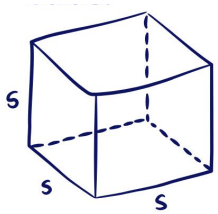
$$\text{Arc Length} = \frac{n^\circ}{360^\circ} \times 2\pi r$$
$$\text{Sector Area} = \frac{n^\circ}{360^\circ} \times \pi r^2$$

Equation of Circles:

$$(x-h)^2 + (y-k)^2 = r^2$$
$$(h,k) : \text{center}$$
$$r : \text{radius}$$

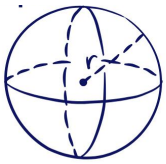
Volume and Surface Area

Cube:



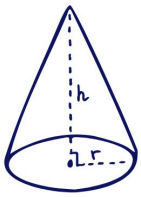
$$V = s^3$$
$$TSA = 6s^2$$

Sphere:



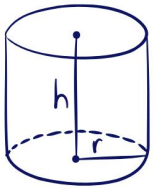
$$V = \frac{4}{3}\pi r^3$$
$$TSA = 4\pi r^2$$

Cone:



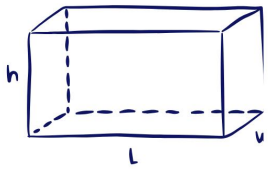
$$V = \frac{1}{3}\pi r^2 h$$
$$TSA = \pi r^2 + \pi r l$$

Cylinder:



$$V = \pi r^2 h$$
$$TSA = 2\pi r^2 + 2\pi r h$$

Rectangular Prism:



$$V = lwh$$
$$TSA = 2(lw + wh + lh)$$

Study Tip!

Don't forget to take care of your overall well-being during your ACT preparation. Ensure you get enough sleep, eat well, and manage stress through relaxation techniques or exercise. Staying healthy and managing your time wisely can have a significant impact on your test performance. Good luck with your ACT preparation!

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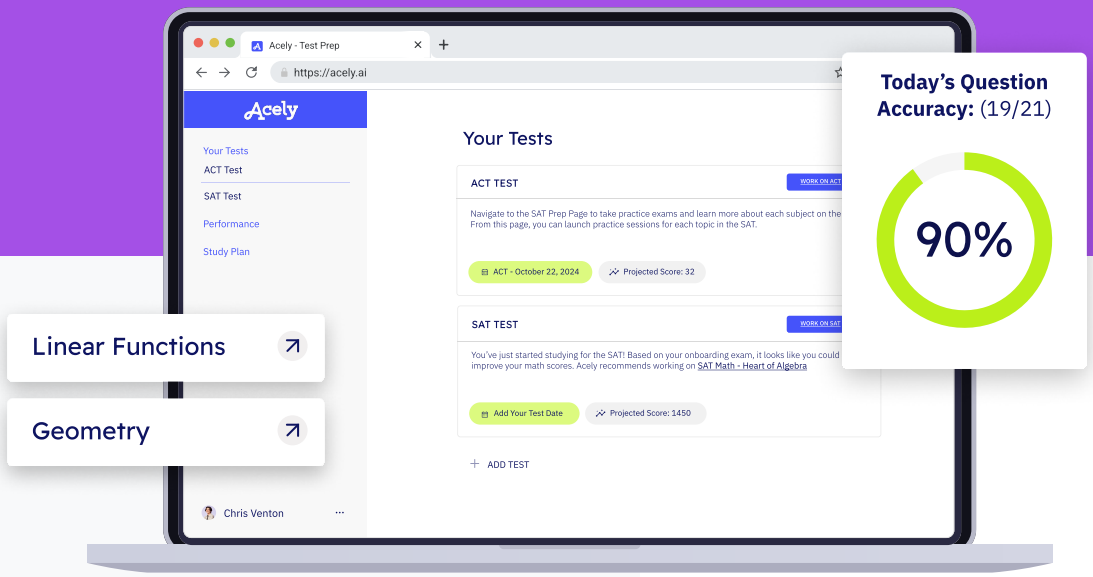

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