100 Math Formula Tricks

Essential Shortcuts, Identities & Mnemonic Strategies

Topics Covered:

Arithmetic • Algebra • Geometry • Trigonometry

Calculus • Statistics • Number Theory

UM Printables

ARITHMETIC

#1 Multiply by 5

Arithmetic

```
n x 5 = (n x 10) / 2
```

MEMORY TRICK

The Magic Mirror: *Multiply by 10 first (just add a zero- easy!). Then look in the mirror to cut it in half.*

Example: 14 x 5 -> 140 / 2 = 70

#2 Multiply by 25

Arithmetic

```
n x 25 = (n x 100) / 4
```

MEMORY TRICK

The Quarter Rule: *25 cents is a quarter dollar. Add two zeros, then slice the pie into 4 quarters!*

Example: 16 x 25 -> 1600 / 4 = 400

#3 Multiply by 11

Arithmetic

```
Split digits; sum in middle
```

MEMORY TRICK

The Sandwich: *The two digits are the bread. Put their sum in the middle as the meat. If the meat is too big (over 9), it spills over into the first slice of bread!*

Example: 35 x 11 -> 3(8)5 = 385. 87 x 11 -> 8(15)7 -> 957

#4 Multiply by 9 (Fingers)

Arithmetic

```
n x 9
```

MEMORY TRICK

The Ninja: *Put both hands up. For 9x3, fold down the 3rd finger. Fingers to the left (2) are the tens, fingers to the right (7) are the ones. 27!*

Example: 9 x 3 -> 27

#5 Multiply by 9 (Mental)

Arithmetic

$$n \times 9 = (n \times 10) - n$$

MEMORY TRICK

The Shortchange: *Pretend you're paying with a 10-dollar bill, but the item costs 'n'. Your change is the answer!*

Example: 7 x 9 -> 70 - 7 = 63

#6 Squares Ending in 5

Arithmetic

$$\text{First part: } n(n+1). \text{ Last: } 25$$

MEMORY TRICK

Slap a Quarter: *Take the front digit, bump it up by one and multiply. Then just slap a quarter (25) on the end!*

Example: 35^2 -> 3x4=12, slap 25 -> 1225

#7 Squares Near 100

Arithmetic

$$\text{If } n = 100 - d, \; n^2 = (n-d) \text{ concat } d^2$$

MEMORY TRICK

The Boomerang: *Subtract the difference from 100 for the first part. Then square the difference and stick it on the end (pad to 2 digits).*

Example: 98^2 -> diff=2. 98-2=96, 2^2=04 -> 9604

#8 Percentage Flip

Arithmetic

$$x\% \text{ of } y = y\% \text{ of } x$$

MEMORY TRICK

The Easy Button: *Flip it to the easier number! Finding 8% of 50 is a headache. Finding 50% of 8 is just half of 8!*

Example: 8% of 50 = 50% of 8 = 4

ALGEBRA

#16 Difference of Squares — Algebra

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

MEMORY TRICK

The Identity Thief: *A square minus a square is always split down the middle! One twin is positive (+), one twin is negative (-).*

Example: $x^2 - 25 = (x + 5)(x - 5)$

#17 Square of a Sum — Algebra

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

MEMORY TRICK

The Double Cheeseburger: *Top bun (a^2), Bottom bun (b^2), and ALWAYS double the cheese (2ab) in the middle!*

Example: $(x + 3)^2 = x^2 + 6x + 9$

#18 Square of a Difference — Algebra

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

MEMORY TRICK

The Moldy Bun: *Same cheeseburger, but the minus sign means the middle cheese is moldy (negative)! Still double it though.*

Example: $(x - 4)^2 = x^2 - 8x + 16$

#19 Product of Sum & Diff — Algebra

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

MEMORY TRICK

The Ghost Middle: *When you FOIL, the Inner and Outer terms cancel out completely! They vanish, leaving only the difference of squares.*

Example: $(2x + 5)(2x - 5) = 4x^2 - 25$

CALCULUS

#56 Power Rule (Derivative)

Calculus

$$d/dx [x^n] = n * x^{(n-1)}$$

MEMORY TRICK

The Slide: *Slide the exponent down the banister to the front. Then kick the exponent down one step. Down in front, drop in back!*

Example: $d/dx [x^5] = 5x^4$

#57 Constant Multiple Rule

Calculus

$$d/dx [c*f(x)] = c * f'(x)$$

MEMORY TRICK

The Innocent Bystander: *Constants just stand on the sidewalk watching the action. Leave them completely alone; only differentiate the moving part.*

Example: $d/dx [6x^3] = 6(3x^2) = 18x^2$

#58 Chain Rule

Calculus

$$d/dx [f(g(x))] = f'(g(x)) * g'(x)$$

MEMORY TRICK

The Russian Nesting Doll: *Derivative of the outer doll (leave the inner doll alone!), TIMES the derivative of the inner doll. Outside, then Inside!*

Example: $d/dx (2x+1)^3 = 3(2x+1)^2(2) = 6(2x+1)^2$

#59 Product Rule

Calculus

$$d/dx [u*v] = u'*v + u*v'$$

MEMORY TRICK

The Swing Dance: *Partner 1 dances (derivative) while Partner 2 watches (stays same). Then they switch! Add the two moves together.*

Example: $d/dx [x^2*\sin x] = 2x*\sin x + x^2*\cos x$

STATISTICS

#66 Mean (Average)

Statistics

$$\text{Mean} = \text{Sum of values} / \text{Number of values}$$

MEMORY TRICK

The Tightrope Walker: *Add up all the weights, then divide by how many people. It's the exact balancing point on the rope!*

Example: Sum=30, n=5 -> Mean = 30/5 = 6

#67 Weighted Mean

Statistics

$$\text{Mean} = \text{Sum}(w_i * x_i) / \text{Sum}(w_i)$$

MEMORY TRICK

The Heavy Backpack: *Some items count more! Multiply by their weight (importance). The heavier items pull the balance point toward them.*

Example: Test 80(w=3), Quiz 90(w=1) -> 330/4 = 82.5

#68 Variance (Population)

Statistics

$$\text{Var} = \text{Sum}(x - \text{mu})^2 / N$$

MEMORY TRICK

The Squared Gap: *How far is everyone from the mean? Square the gaps so negatives don't cancel positives. Then average the squared gaps!*

Example: For 2,4,6: Var = $[(4-4)^2+(2-4)^2+(6-4)^2]/3 = 8/3$

#69 Standard Deviation

Statistics

$$\text{SD} = \text{sqrt}(\text{Variance})$$

MEMORY TRICK

The Un-Squarer: *Variance is in weird 'squared units'. Take the square root to get back to normal units. It's the 'average distance from the mean'.*

Example: If Var = 8/3, SD = sqrt(8/3) = 1.63

NUMBER THEORY

#83 Even * Any = Even

Number Theory

$$\text{Even} \times \text{Any Integer} = \text{Even}$$

MEMORY TRICK

The 2 Multiplier: *Even numbers have a secret 2 hiding inside. Anything times 2 is Even! The 2 always escapes.*

Example: 4 x 5 = 20 (Even)

#84 Odd * Odd = Odd

Number Theory

$$\text{Odd} \times \text{Odd Integer} = \text{Odd}$$

MEMORY TRICK

The No-2 Club: *Odd numbers have no 2 hiding inside. You can't magically create a 2 by multiplying numbers that don't have one!*

Example: 3 x 5 = 15 (Odd)

#85 Zero Factorial

Number Theory

$$0! = 1$$

MEMORY TRICK

The Empty Stage: *How many ways can you arrange zero items? Exactly 1 way: do nothing! The stage is empty, but the show still counts as 1.*

Example: 5C5 = 5! / (5!0!) = 1 / 1 = 1

#86 Euclidean Algorithm

Number Theory

$$\text{GCD}(a, b) = \text{GCD}(b, a \bmod b)$$

MEMORY TRICK

The Remainder Swap: *Divide, then replace the big number with the small number, and the small number with the remainder. Repeat until the remainder is 0!*

Example: GCD(48,18) -> GCD(18,12) -> GCD(12,6) = 6

#99 Euler's Totient (Prime p)

Number Theory

```
phi(p) = p - 1
```

MEMORY TRICK

The Coprime Counter: *For a prime p, EVERYTHING smaller than it is coprime! So just count down: p-1.*

Example: Numbers coprime to 7: {1,2,3,4,5,6} -> 6

#100 Twin Primes

Number Theory

```
Pairs (p, p+2) that are both prime
```

MEMORY TRICK

The Gap of 2: *Primes separated by exactly one even number (2). Like 11 and 13. The only triplet is 3, 5, 7!*

Example: 11 and 13, 17 and 19

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