# *Powers / Roots*

## Perfect Squares

| $n^2$ | $\sqrt{P}$ | | $n^2$ | $\sqrt{P}$ |
|---|---|---|---|---|
| $11^2 = 121$ | $\sqrt{121} = 11$ | | $16^2 = 256$ | $\sqrt{256} = 16$ |
| $12^2 = 144$ | $\sqrt{144} = 12$ | | $17^2 = 289$ | $\sqrt{289} = 17$ |
| $13^2 = 169$ | $\sqrt{169} = 13$ | | $18^2 = 324$ | $\sqrt{324} = 18$ |
| $14^2 = 196$ | $\sqrt{196} = 14$ | | $19^2 = 361$ | $\sqrt{361} = 19$ |
| $15^2 = 225$ | $\sqrt{225} = 15$ | | $20^2 = 400$ | $\sqrt{400} = 20$ |

## Powers of 2

Benchmarks: Two to the six begins with six, two to the ten begins with ten.

| $2^n$ | $\sqrt[n]{P} = 2$ | | $2^n$ | $\sqrt[n]{P} = 2$ |
|---|---|---|---|---|
| $2^1 = 2$ | -- | | $2^7 = 128$ | $\sqrt[7]{128} = 2$ |
| $2^2 = 4$ | $\sqrt{4} = 2$ | | $2^8 = 256$ | $\sqrt[8]{256} = 2$ |
| $2^3 = 8$ | $\sqrt[3]{8} = 2$ | | $2^9 = 512$ | $\sqrt[9]{512} = 2$ |
| $2^4 = 16$ | $\sqrt[4]{16} = 2$ | | $2^{10} = 1{,}024$ | $\sqrt[10]{1{,}024} = 2$ |
| $2^5 = 32$ | $\sqrt[5]{32} = 2$ | | $2^{11} = 2{,}048$ | $\sqrt[11]{2{,}048} = 2$ |
| $2^6 = 64$ | $\sqrt[6]{64} = 2$ | | $2^{12} = 4{,}096$ | $\sqrt[12]{4{,}096} = 2$ |

## Cubes and Powers of 3

| $n^3$ | $\sqrt[3]{P}$ | | $3^n$ | $\sqrt[n]{P} = 3$ |
|---|---|---|---|---|
| $1^3 = 1$ | $\sqrt[3]{1} = 1$ | | $3^1 = 3$ | -- |
| $2^3 = 8$ | $\sqrt[3]{8} = 2$ | | $3^2 = 9$ | $\sqrt{9} = 3$ |
| $3^3 = 27$ | $\sqrt[3]{27} = 3$ | | $3^3 = 27$ | $\sqrt[3]{27} = 3$ |
| $4^3 = 64$ | $\sqrt[3]{64} = 4$ | | $3^4 = 81$ | $\sqrt[4]{81} = 3$ |
| $5^3 = 125$ | $\sqrt[3]{125} = 5$ | | $3^5 = 243$ | $\sqrt[5]{243} = 3$ |

Powers of 10: $10^n$ = "One followed by $n$ zeroes." Naming the commas:

$$100{,}000{,}000{,}000{,}000$$

Trillion    Billion    Million    Thousand
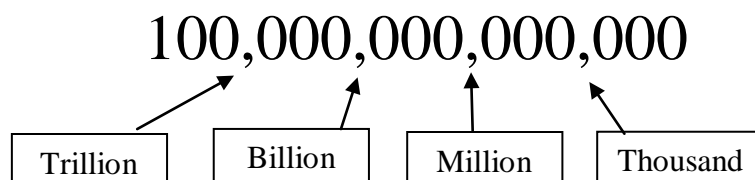
# Medium Level Tables

## *Fraction / Decimal Equivalents*

| | NUMERATOR | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1/** | **2/** | **3/** | **4/** | **5/** | **6/** | **7/** | **8/** | **9/** | **10/** | **11/** |
| **/2** | 0.5 | | | | | | | | | | |
| **/3** | $0.\overline{3}$ | $0.\overline{6}$ | | | | | | | | | |
| **/4** | 0.25 | | 0.75 | | | | | | | | |
| **/5** | 0.2 | 0.4 | 0.6 | 0.8 | | | | | | | |
| **/6** | $0.1\overline{6}$ | | | | $0.8\overline{3}$ | | | | | | |
| **/7** | $0.\overline{142857}$ | $0.\overline{285714}$ | $0.\overline{428571}$ | $0.\overline{571428}$ | $0.\overline{714285}$ | $0.\overline{857142}$ | | | | | |
| **/8** | 0.125 | | 0.375 | | 0.625 | | 0.875 | | | | |
| **/9** | $0.\overline{1}$ | $0.\overline{2}$ | | $0.\overline{4}$ | $0.\overline{5}$ | | $0.\overline{7}$ | $0.\overline{8}$ | | | |
| **/10** | | | | | | | | | | | |
| **/11** | $0.\overline{09}$ | $0.\overline{18}$ | $0.\overline{27}$ | $0.\overline{36}$ | $0.\overline{45}$ | $0.\overline{54}$ | $0.\overline{63}$ | $0.\overline{72}$ | $0.\overline{81}$ | $0.\overline{90}$ | |
| **/12** | $0.08\overline{3}$ | | | | $0.41\overline{6}$ | | $0.58\overline{3}$ | | | | $0.91\overline{6}$ |
| **/20** | 0.05 | | 0.15 | | | | 0.35 | | 0.45 | | *etc.* |
| **/25** | 0.04 | 0.08 | 0.12 | 0.16 | | 0.24 | 0.28 | 0.32 | 0.36 | | *etc.* |
| **/50** | 0.02 | | 0.06 | | | | 0.14 | | 0.18 | | *etc.* |

# Medium Level Tables
## *Miscellaneous Number Facts*

## Irrational Approximations

$\sqrt{2} \approx 1.4$
$\sqrt{3} \approx 1.7$
$\sqrt{5} \approx 2.2$
$\pi \approx 3.1$ (in most cases, it's good enough to know that $\pi = 3+$)

## Pythagorean Triplets

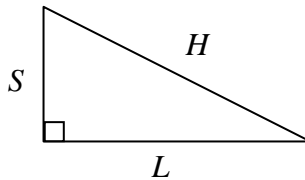**3**, 4, 5
**5**, 12, 13
**7**, 24, 25
**8**, 15, 17
**9**, 40, 41

## Prime Numbers

2, 3, 5, 7, 11, …

## The 30-60-90 triangle

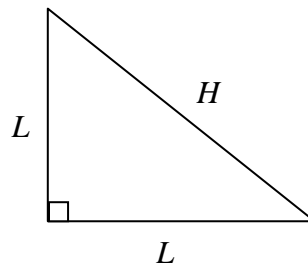Has a short leg (S), a long leg (L), and a hypotenuse (H).

They come in the ratio $S : L : H = 1 : \sqrt{3} : 2$ or $\dfrac{S}{1} = \dfrac{L}{\sqrt{3}} = \dfrac{H}{2}$

In other words, $L = S\sqrt{3}$ and $H = 2S$

## The 45-45-90 triangle

Has two congruent legs (L) and a hypotenuse (H).

They come in the ratio $H = L\sqrt{2}$

# *Powers / Roots*

Perfect Squares

| | | | |
|---|---|---|---|
| $11^2 =$ | | $16^2 =$ | |
| $12^2 =$ | | $17^2 =$ | |
| $13^2 =$ | | $18^2 =$ | |
| $14^2 =$ | | $19^2 =$ | |
| $15^2 =$ | | | |

Powers of 2

| | | | |
|---|---|---|---|
| $2^1 =$ | | $2^7 =$ | |
| $2^2 =$ | | $2^8 =$ | |
| $2^3 =$ | | $2^9 =$ | |
| $2^4 =$ | | $2^{10} =$ | |
| $2^5 =$ | | $2^{11} =$ | |
| $2^6 =$ | | $2^{12} =$ | |

Cubes and Powers of 3

| $n^3$ | | $3^n$ | |
|---|---|---|---|
| $1^3 =$ | | $3^1 =$ | |
| $2^3 =$ | | $3^2 =$ | |
| $3^3 =$ | | $3^3 =$ | |
| $4^3 =$ | | $3^4 =$ | |
| $5^3 =$ | | $3^5 =$ | |

Powers of 10: $10^n =$ "One followed by $n$ zeroes."  Naming the commas:

$$100,000,000,000,000$$

## Fraction / Decimal Equivalents

| | | NUMERATOR | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1/** | **2/** | **3/** | **4/** | **5/** | **6/** | **7/** | **8/** | **9/** | **10/** | **11/** |
| D E N O M I N A T O R | **/2** | | | | | | | | | | | |
| | **/3** | | | | | | | | | | | |
| | **/4** | | | | | | | | | | | |
| | **/5** | | | | | | | | | | | |
| | **/6** | | | | | | | | | | | |
| | **/7** | | | | | | | | | | | |
| | **/8** | | | | | | | | | | | |
| | **/9** | | | | | | | | | | | |
| | **/10** | | | | | | | | | | | |
| | **/11** | | | | | | | | | | | |
| | **/12** | | | | | | | | | | | |
| | **/20** | | | | | | | | | | | *etc.* |
| | **/25** | | | | | | | | | | | *etc.* |
| | **/50** | | | | | | | | | | | *etc.* |
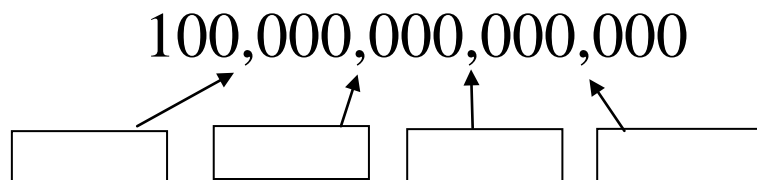
# *Miscellaneous Number Facts*

Irrational Approximations

$\sqrt{2} \approx$
$\sqrt{3} \approx$
$\sqrt{5} \approx$
$\pi \approx$

Pythagorean Triplets

___, ___, ___
___, ___, ___
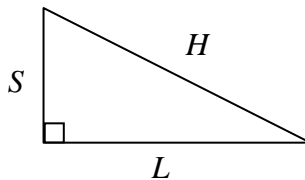___, ___, ___
___, ___, ___
___, ___, ___

Prime Numbers

___, ___, ___, ___, ___ , ···
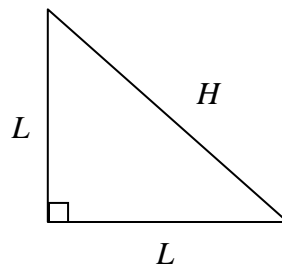
The 30-60-90 triangle

Has a short leg (S), a long leg (L), and a hypotenuse (H).



They come in the ratio $S : L : H = $ ___ : ___ : ___

The 45-45-90 triangle

Has two legs (L) and a hypotenuse (H).



They come in the ratio $H = L \cdot$ _____