

Ad Hoc Math Problems

Section 5.1–5.2

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acm International Collegiate
Programming Contest

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More group therapy

Some problems are “easier” than others

(see projecteuler.net for even more fun)

Logarithms

Definition

$$y = b^x \Leftrightarrow x = \log_b(y)$$

Properties

$$\log_b(xy) = \log_b(x) + \log_b(y)$$

$$\log_b\left(\frac{x}{y}\right) = \log_b(x) - \log_b(y)$$

$$\log_b(x^n) = n \log_b(x)$$

$$\log_b \sqrt[n]{x} = \frac{\log_b(x)}{n}$$

<http://en.wikipedia.org/wiki/Logarithm>

Change of base

For any value k :

$$\log_b(x) = \frac{\log_k(x)}{\log_k(b)}$$

```
#include <cmath>
```

```
log(x)    // base e (natural log)
```

```
log10(x)  // base 10 (common log)
```

Exercise 5.2.1

How to compute $\log_b(x)$ in C++?

Other math tricks

Exercise 5.2.2

```
1 + (int) log10(x)
```

Answer: Number of digits in x

Exercise 5.2.3

How to compute $\sqrt[n]{x}$ in C++?

Answer: Compute $x^{1/n}$

▶ `pow(x, 1.0 / n)`

▶ `exp(log(x) / n)` `pow(a, b) = exp(log(a) * b)`

Today's problems

- ▶ UVa 10281 - Average Speed (distance = speed \times time)
- ▶ UVa 01225 - Digit Counting (extract and count the digits)
- ▶ UVa 10035 - Primary Arithmetic (count the carry operations)
- ▶ UVa 10751 - Chessboard (use diagonal as much as possible)
- ▶ UVa 10940 - Throwing Cards Away II (find with brute force)

- ▶ UVa 00264 - Count on Cantor (math, grid, pattern)
- ▶ UVa 00443 - Humble Numbers (try all $2^i \times 3^j \times 5^k \times 7^l$, sort)
- ▶ UVa 00701 - Archeologists Dilemma (count the # of digits)
- ▶ UVa 00498 - Polly the Polynomial (straightforward evaluation)
- ▶ UVa 10137 - The Trip (be careful with precision error)