

# Test 1 Study Sheet

## Math 100 – Spring 2001

### Chapter 1: Silly Stories (and their morals)

- *Meanie Genie, Fountain of Knowledge, Dodge Ball*. You should be familiar with these problems and their solutions. (Note that complete solutions to each are presented in Sections 1.2 and 1.3.)
- You may be asked to work on a problem that is similar to these. Similar might mean only a small change (different sizes of cups in *Fountain of Knowledge*), or a problem that can be solved using similar thinking (like *Cannibals and Missionaries*).
- The homework problems assigned from Chapter 1 give examples of the types of problem solving activities you might see.
- If I were to give you a problem solving task that you cannot solve, be sure to show the work you do in a reasonably coherent manner, since it is possible to get significant credit without actually solving the problem if you show that you were using reasonable methods to attack the problem.

### Locker problem.

- You should have a good understanding of the solution to this problem, including things like: relationship to factoring (divisors), relationship to square numbers, relationship between square numbers and the pattern of runs of closed lockers, facts that can be learned from a round by round approach

### Section 2.1: Counting

- Pigeon-hole principle (sock hop problem, for example).
- Making reasonable estimates (and knowing if they are too big or too small).

### Section 2.2: Numerical Patterns in Nature

- How Fibonacci sequence works.
- Where Fibonacci sequence shows up in nature.
- Relationship between golden ratio ( $\varphi$ ) and Fibonacci numbers.

### Section 2.3: Prime Numbers

- Definition of prime number, factor, divisor, multiple, remainder
- Geometric interpretation of multiplication and remainders (rectangular arrays).
- Every number can be written as a product of prime numbers multiplied together. (Why?, How?)
- Finding/recognizing prime numbers.  
Sieve of Eratosthenes. Time saving observations when trying to prove a number is prime. How to find a prime number larger than any specified number and the proof that there is no largest prime number.

### Section 2.4: Modular Arithmetic (Clock Arithmetic)

- Modular arithmetic basics (addition, subtraction, multiplication, exponents)
- Error-correcting codes (UPC, bank, ISBN)

### Section 2.5: Secret Codes (Public key and private key)

- Difference between private key and public key cryptography
- Caesar-like Cyphers. How it works, why it isn't public key, how to crack if done letter by letter, idea of "block encoding"
- RSA. How it works (outline), why it is public key
- role of large prime numbers in RSA

### General.

- Think about what we learned about and from mathematics by doing these activities and problems.