1 Topic Outline:

The following outline contains all of the major topics that you will need to know for the exam. Any topic that we’ve discussed in class so far may appear on the exam, but most questions will be based on items from this list.

1. Number Systems
   (a) Egyptian Numerals
   (b) Roman Numerals
   (c) Place Value Systems
      i. Chip Models
      ii. Expanded Form
      iii. Alternative Number Bases
         A. Converting from one base to another
         B. Computing addition and multiplication tables
         C. Computing within an alternative number base

2. Properties of Arithmetic
   (a) Commutativity of addition and multiplication
   (b) Associativity of addition and multiplication
   (c) Identities for addition and multiplication
   (d) Distributive Property
   (e) Using these properties for mental math strategies
3. Models for Arithmetic

(a) Set Model
(b) Measurement Model
(c) Rectangular Array Model for Multiplication
(d) Partitive vs. Measurement Division
(e) Writing word problems illustrating each model
(f) Writing “Teacher’s Solutions”
   i. Bar Diagrams

4. Algorithms

(a) Addition Algorithms
   i. Standard Algorithm
   ii. Lattice Addition
(b) Subtraction Algorithms
   i. Standard Algorithm
   ii. Subtract from 10 Algorithm
(c) Multiplication Algorithms
   i. Standard Algorithm
   ii. Partial Products Algorithm
   iii. Lattice Multiplication
(d) Division Algorithms
   i. Standard Long Division Algorithm
   A. Estimation

2 Sample Problems

The following problems are intended to help you test your knowledge of the major topics on the exam. They are not intended to resemble the actual questions on the exam (although I hope that anyone who is comfortable solving these problems will also do well on the exam). These questions are organized roughly in the order that the topics appear in the above list.

Problem 1. 1. Write down the addition and multiplication tables for Base-11 arithmetic (Use “a” to represent the 11th digit in this system).
2. Use these tables to compute \((3a2)_{11} + (759)_{11}\).

3. Use these tables to compute \((473)_{11} \times (a16)_{11}\).

4. Convert \((a02)_{11}\) into base 6. (Hint: It may be useful to convert this number into base 10 first.)

**Problem 2.**

1. It is possible to show using only the commutativity and associativity of addition that \((4+5)+(7+9)\) is equal to \(((5+7)+4)+9\). Demonstrate how this can be done, using only one property on each step and indicating which property is used on each step.

2. Using only commutativity and associativity of addition and multiplication and the distributive property, show that \(3(2 + 4) + 5 \times 3\) = \((2 + (5 + 4)) \times 3\). As above, use only one property on each step, and label each step with the property that you used.

**Problem 3.**

1. Write two word problems whose solutions use the equation \(4 \times 15 = 60\). Use the set model for arithmetic in one problem, and use the measurement model in the other.

2. Write two word problems, one using the partitive model for division and one using the measurement model for division, whose solutions use the equation \(30 \div 6 = 5\).

**Problem 4.** Write teacher’s solutions for the following word problems:

1. Alice, Bob, and Carl each planted 17 flowers in the school garden. How many total flowers did they plant?

2. Alice, Bob, Carl, and Dave collect stamps. Alice has three times as many stamps as Bob, Bob has twice as many stamps as Carl, and Dave has five times as many stamps as Carl. Together, they have 42 stamps. How many stamps does Alice have?

**Problem 5.**

1. Find 352 + 763 using both the standard algorithm and lattice addition.

2. Find 97 \times 435 using the standard algorithm, the partial products algorithm, and the lattice algorithm.

3. Write the full long division algorithm for 8735 \div 23.