Mathematics for Elementary School Teachers
Exam 1
February 23, 2001

The point value of each problem is given in the margin.

(8) 1. Identify each of the following sequences as arithmetic, geometric or neither and answer the questions asked.
   (a) In the first year of her job, Nancy earned 17 thousand dollars. Her salary increased by five thousand dollars each year for the next 50 years. Type of sequence? ________. What was her salary in the 43-rd year?
   (b) The population of a colony is currently 47 and it doubles every year? Type of sequence? _________. What is the population in the 15-th year? (expressed in exponent notation)

(5) 2. Make a Venn diagram to illustrate $B \cup A$

(8) 3. Let $A = \{x|x > 0 \text{ and } x \text{ is even}\}$, $B = \{x|x > 5\}$, $C = \{2, 4, 6, 8, 10\}$.
   (a) Find $A - B$
   (b) Find $(A \cap B) \cup C$

(8) 4. a) Write the following as a base-10 numeral.
   $7 \cdot 10^6 + 2 \cdot 10^5 + 3 \cdot 10^2 + 3 =$
   b) Write the following base-10 numeral in expanded form.
   20030050

(6) 5. Recall the Roman numerals $L = 50$, $C = 100$, $D = 500$, $M = 1000$.
   (a) What year is it now in Roman numerals?
   (b) Identify the year MCDXCII.
6. Express the following binary number in base-10.

\[1100101_{two} = \]

7. Express the base-10 numeral 197 in base-5.

8. Fill in the blank and indicate the law illustrated. (Spelling counts!)
   (a) \((12 + 13) + 47 = 12 + (13 + \_\_)\)
   (b) \(17(x + a) = (x + \_\_)17\)
   (c) \(3(x + w) = 3x + \_\_)\)

9. Determine whether the following sets are closed under the given operation. If not give a counterexample.
   (a) \(\{−1, 0, 1\}\) under addition.
   (b) \(\{0, 1, 2, 3, 4, 5, 7, 8, \ldots\}\), the set of whole numbers without 6, under multiplication?
   (c) The set of integers under subtraction?

10. Estimate. (Do not calculate.)
    (a) \(21039 \times 7987 \approx\) (to the nearest million)
    (b) \(2101345 − 75110 \approx\) (to the nearest million)
    (c) \(92630 ÷ 313 \approx\)
11. A function \( f(x) \) is given by the set of ordered pairs 
\[ \{(1, 5), (2, 9), (3, 13), (4, 17)\} . \]
(a) What is the domain of the function \( f(x) \)?

(b) Give a formula for the function \( f(x) \).

(c) Draw an arrow diagram for \( f(x) \).

12. A student is trying to understand why we add exponents in the law of exponents \( b^n b^m = b^{n+m} \). Explain it using a good example.

13. (a) Use long division to find the quotient and remainder for \( 2435 \div 8 \) and then put your answer in the form \( a = bq + r \). Indicate what each number in the long division process represents.

(b) In general when calculating \( a \div b \) what inequality does the remainder \( r \) satisfy? Is there any restriction on what the whole numbers \( a \) or \( b \) can be? (If so, state it.)