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Mathematics for Elementary School Teachers
Exam I
February 11, 2000

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

(12) 1. Identify each of the following sequences as arithmetic, geometric, or neither, and find the next two terms in each sequence.

a) 14, 21, 28, 35, 42, 49, ...

b) $\frac{1}{3}$, 1, 3, 9, 27, ...

c) 1, 2, 7, 16, 29, 46, ...

(12) 2.a) Calculate the sum $2 + 4 + 6 + \cdots + 198$

b) If the tenth term in an arithmetic sequence is 210 and the fifteenth term is 275, find the eighteenth term.

c) If the third term in a geometric sequence is 6 and the fifth term is 150, find the first term.

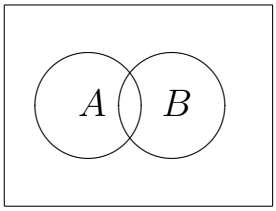
(12) 3.a) Let $\mathbb{N}$ be the set of all natural numbers and let $2\mathbb{N}$ be the set of all even numbers. Are $\mathbb{N}$ and $2\mathbb{N}$ in $1-1$ correspondence, and, if so, demonstrate a $1-1$ correspondence between the sets.

b) Let A have cardinality 5 and B have cardinality 3. What is the largest cardinality that $A \cap B$ can have, and under what circumstances does this happen?

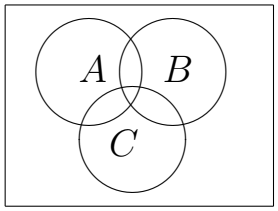
c) Let A have cardinality 10 and B have cardinality 20. What is the largest cardinality that $A \cup B$ can have, and under what conditions can this happen?

(10) 4. Shade the following regions in the Venn Diagrams below.

a) $\overline{A} \cap B$



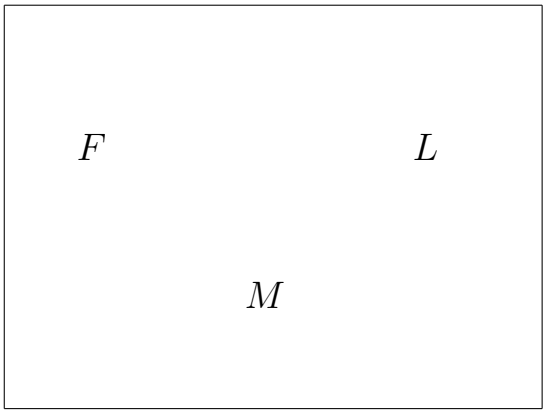
b) $(A \cup B) \backslash C$



(10) 5.a) An automobile shop has 24 cars with flat tires, 15 needing oil, 7 needing new mufflers, 2 needing new mufflers and oil, 11 with flat tires needing oil, 3 with flat tires needing new mufflers, and one car with a flat tire, a broken muffler and needing oil.

Let $F =$ flats, $L =$oil, $M =$muffler.

a) Illustrate this information on a Venn Diagram by writing the appropriate numbers in the various regions.



b) If there are 50 cars altogether in the shop, how many of them don't have any of its problems labeled in part a)? (There is only one answer to the problem.)

(12) 6.a) How many ways can 10 teams play each other four times?

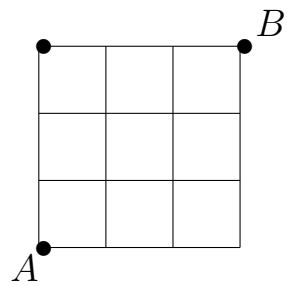
b) John has 3 different shirts, 5 different trousers, and 2 different sports coats. How many different outfits can he choose?

(12) 7.a) Complete the following magic square; that is, complete the square so that the sum in each row, each column, and each diagonal is the same.

2	7	6
		8

b) Looking out in a backyard one day, Tom saw an assortment of boys and dogs. Counting heads he got 22. Counting feet, he got 68. How many boys and how many dogs were in the yard?

c) How many ways are there of going from A to B if you can only travel along the grid below either up or to the right.



(20) 8. If $A = \{1, 2, 3\}$, $B = \{a, 2, 7, 11\}$ and $C = \{2, 6\}$ find:

a) $A \backslash B = \left\{ \qquad\qquad\qquad\qquad\qquad\qquad \right\}$

b) $A \cup B = \left\{ \qquad\qquad\qquad\qquad\qquad\qquad \right\}$

c) $A \times C = \left\{ \qquad\qquad\qquad\qquad\qquad\qquad \right\}$

d) $C \times A = \left\{ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \right\}$