Math 4 Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**1-7 Summation Notation** Date\_\_\_\_\_\_\_\_

**paradox:** *a statement, proposition, or situation that seems to be absurd or contradictory, but in fact*

*is or may be true*

The Greek philosopher Zeno of Elea lived around 450 B.C and is now famous for his paradoxes. One of them involves a runner who is trying to go from point *A* to point *B*. Zeno pointed out that the runner would first have to go half the distance, then half the remaining distance, and so forth. Suppose the runner travels at a constant speed, taking one minute to go half the distance from *A* to *B*. It will then take minute to go half of the remaining distance, minute to go half of the new remaining distance, and so forth.

Zeno observed that the total time required for the runner to reach point *B* would have to equal the sum of an *infinite* collection of positive numbers:



*Summation notation*, or *sigma notation*, is very convenient for concisely representing sums such as that arising from this paradox of Zeno. This notation uses the symbol (the Greek capital letter sigma).

The infinite sum above could be written as 

**Definition of Summation Notation**



*The symbol* *is read “the sum of the numbers ai from i = m to i = n.”*

*Writing* *as is called* ***expanded form***

1. Write in expanded form and find the value of this sum.

2. Write in expanded form and find the value of this sum.

3. Consider the summation 

a. Write the expanded form of the summation for *n* = 1

b. Write the expanded form of the summation for *n* = 4 and approximate its value.

4. Write the following sums in summation notation. You do NOT have to find the sum.

a.  b. 

c.  d. 

5. Expand the first several terms of the following summation and then attempt to find the sum:

 