Approximating Square Roots:

A. Square roots are a common approximation problem and can be somewhat challenging since some educated guessing is involved.

B. The good thing about square roots is we can often get the answer in a somewhat close range. This method is very similar to finding the exact value of a square root.

1. Mentally take off 2-digits at a time, starting from the right, until you are left with a manageable square root (i.e. one that you can find a range of 5 with). Usually you want 3 or 4 numbers to work with. (*If you are using just 3 numbers you want a range of 1.*)

2. Judging from the value under the square root make an educated guess as to where in the range of 5 it might fall. Write this down. (For details on how to get a range of 5, see finding the exact value of a square root.)

3. Add 1 zero to the end for every 2 digits you took off from step 1.

   Ex [1]  \( \sqrt{139456} = \) __________.
   a. Taking off 2-digits at a time, we are left 1394.
   b. We know \( 35^2 = 1225 \) and \( 40^2 = 1600 \). 1394 is closer to 1225 than it is to 1600, so we might want 37. Write 37.
   c. Add one 0 since we took off two numbers.
   d. We get 370.
   e. The answer can be between 355 and 392.

   Ex [2]  \( \sqrt{2439761} = \) __________.
   a. Taking off 2-digits at a time, we are left with 243. (*Note, there were 4 digits taken off*).
   b. We know that \( 15^2 = 225 \) and \( 16^2 = 256 \). Now we must make an educated guess. 243 is between 225 and 256 so we could use 15.5 for the middle.
   c. If we do we would get 1550 for the answer. (*Notice instead of just adding 2 0's we moved the decimal over 1 and added 1 zero.*)
   d. The answer can be between 1483 and 1640.
C. On problems like Ex [2], the numbers are large so we have a lot of leniency. You
don't have to take a lot of time on guessing as you should already be close. In Ex[1]
we have smaller numbers but you can see by the range that it is not necessary to
spend a lot of time in making a decision. The guessing is just to get you closer, just
in case.