Help on Question #5 of the Vector Dart Lab:

Given x ±∆x (ave and std dev of horizontal positions) and y ±∆y (ave and std dev of vertical positions) you need to propagate these absolute errors through the equation $r=\sqrt{x^{2}+y^{2}}$ to determine the absolute error in the radial displacement of your average dart. The strategy is to work from the inside out, function by function.

1. x2 : This is an exponential calculation so you need to find the fractional uncertainty in x (∆x/x) and multiply it by 2 to find the fractional uncertainty in x2 : (∆x2/x2) . To find the absolute uncertainty in x2 , ∆x2, multiply the fractional uncertainty in x2 BY the value of x2. The result is the absolute uncertainty in x2, ∆x2.
2. y2 : Repeat #1 for y2.
3. x2 + y2 : This is an addition, so the absolute uncertainty in x2 + y2 , ∆( x2 + y2), is the simple sum of ∆x2 and ∆y2. (But you still need to determine the value of x2 + y2 for the next step.)
4. Square root of x2 + y2: This is another exponential calculation with the exponent = ½. Find the fractional uncertainty in x2 + y2 (∆x2 + y2/ x2 + y2) and multiply it by 1/2 to find the fractional uncertainty in $r=\sqrt{x^{2}+y^{2}}$ , $\left(\frac{∆\sqrt{x^{2}+y^{2}}}{\sqrt{x^{2}+y^{2}}}\right)=\frac{∆r}{r}$ . To find the absolute uncertainty in r (which = the absolute uncertainty in$\sqrt{x^{2}+y^{2}}$, you multiply the fractional uncertainty $\left(\frac{∆\sqrt{x^{2}+y^{2}}}{\sqrt{x^{2}+y^{2}}}\right) $by the value of $\sqrt{x^{2}+y^{2}}$.