Name: _____

Error Propogation

Now that you've learned about **absolute error** and **relative error**, let's take a look at how we use them when propagating our errors.

Let's say we have three numbers ***a*** = 7.48 ± 0.03 ***b*** = 1.3 ± 0.2 and ***c*** = 9 ± 1

Adding and Subtracting

For adding and subtracting numbers, you _____ their _____ errors.

On your data booklet, the general form for this for this operation is:

_____

*Note: the "±" symbol above means adding or subtracting, not *uncertainty*.

Ex 1. $\boldsymbol{a} - \boldsymbol{b}$ =? Ex. 2 $\boldsymbol{a} + \boldsymbol{b}$ =?

Inquiry question: In which example is the relative error of your answer larger? Why?

Multiplying by an errorless number

When multiplying your number by an errorless number, ***p***, you _____ your _____ error by ***p***.

Your data booklet does not have the general form for this operation, but we can simply write it as

_____

Recall, that we did an example of this when you were calculating your uncertainties, there was one more step in that calculation to account for your time measuring for 10 oscillations.

Ex. 3 What is the error of $\pi\boldsymbol{a}$?

Inquiry question: If you took the relative error of ***a*** and multiplied it by $\pi\boldsymbol{a}$, would that give you the same answer as Ex.3? Show your work to help you explain.

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Multiplying and Dividing

For multiplying and dividing numbers, you _____ their _____ errors

On your data booklet, the general form for this for this operation is:

_____

Notice that _____ represents _____ error. In order to leave your answer in absolute error, you need to multiply your final answer, ***y***, by your calculated relative error.

Ex. 4 $\frac{ab}{c} = ?$

Ex. 5 $\frac{b}{ac} = ?$

Exponents

For taking your number to a certain power ***n***, you _____ your number's _____ error by ***n***,

then take its _____ (_____).

On your data booklet, the general form for this for this operation is:

_____

Notice that _____ represents _____ error. In order to leave your answer in absolute error, you need to multiply your final answer, ***y***, by your calculated relative error.

Ex. 6 $b^2 = ?$

$y = 1.3^2 = 1.69$

$\frac{\Delta y}{y} = \left|2\left(\frac{0.2}{1.3}\right)\right|$

$= 0.30075\ldots$

$\Delta y = 1.69 \times 0.30075\ldots$

$= 0.50827$

$1.69 \pm 0.50827\ldots$

1.7 ± 0.5

Ex. 7 $\sqrt{c} = ?$ $n = \frac{1}{2}$

Ex. 8 $\frac{1}{a^2} = ?$ $n = -2$

$y = \frac{1}{7.48^2} = 0.01787\ldots$

$\frac{\Delta y}{y} = \left|-2\left(\frac{0.03}{7.48}\right)\right| = 0.00802\ldots$

$\Delta y = 0.01787\ldots \times 0.00802\ldots$

$= 0.000143366\ldots$

$0.01787 \pm 0.00143\ldots$

0.0179 ± 0.0001

or

$(1.79 \pm 0.01) \times 10^{-2}$