Part 1

1. Define significant figures
   Number of digits reported for the values of a measured or calculated quantity

2. How is a number's number of significant figures different from its number of decimal places?
   The significant figures can include numbers to the left of the decimal point. For example, 405.5 has one decimal places, but 4 significant figures.

3. Rules for zeros
   Zeros are significant when
   1. They are between other significant figures
   2. zeros to right of number, but after decimal point

   Zeros are not significant when
   1. Preceding a decimal point with no numbers to the left
   2. Precede first non-zero digit and

4. Rules for multiplication and division
   Result should have no more significant figures than the factor with the fewest significant digits

5. Rules for addition and subtraction
   Give same number of decimal places as there are in the factor with the least number of decimal places

6. Rules for exact numbers
   Do not factor into significant figures calculations

Part 2

1.

Number	Decimal places	Significant figures
$\overline{376}$	0	3
$\overline{376.0}$	1	4
$\overline{376}908$	0	6
$\overline{376}0000$	0	3
$0.\overline{376}$	3	3
$0.\overline{3760000}$	6	6
$\overline{3.76}\times10^{-6}$	2	3

2. $(\overline{2.43})(17.675) = 43.0$
3. $(2.479\text{ h})(60\text{ min/h}) = 100$
4. $1725.463 - 489.\overline{3} + 6.73 = 1243.0$
5. $9030000 + 54600 + 104\,470 = 1067070$

Part 3

1. Define Error and uncertainty
   Error: Difference between measured value and true value
   Uncertainty: Difference between measured value and ideally measured value.
   If your model is accurate, uncertainty and error are the same thing.

2. One-unit rule:
   When there is no uncertainty range given, it is assumed to be ±1 of the least significant significant figure

   One tenth rule
   When using an analog measurement such as a ruler, the uncertainty is ±1 the digit past the least significant significant digit

3. Define precision and accuracy
   Precision is the ability to hit the same spot every time.
   Accuracy is the ability to average over the correct spot.

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4. How does uncertainty differ for analog and digital devices?
Analog devices use one tenth rule
Digital devices use one unit rule

Problems:

1. Estimate measurement with one tenth rule
Ruler → 64.4 ± 0.1 Cylinder → 63.5 ± 0.1

2. Calculate and determine uncertainty:
a. 3.2 + 6.02 = 9.2 ± 0.1
b. 21 × 8.5 = 120 ± 1
c. (3.5 − 1.005) / 55.6 = 0.045 ± 0.1

3 Error Propagation
a. Determine R = A + B where A = 4.5 ± 0.3 m and B = 3.7 ± 0.2 m
R = 8.2 U_R = 0.5
R = 8.2 ± 0.5 m
b. Determine R = A × B where A = 2.0 ± 0.3 m and B = 3.0 ± 0.2 m
R = 6.0 U_R = 0.5
R = 6.0 ± 0.5 m

c R = A × B − C where A = 3.0 ± 0.2 B = 4.0 ± 0.2 C = 9.15 ± 0.08
R = 3 ± 0.9

4 Calculate mean and standard deviation

Trial	Measurement
1	11.7
2	10.7
3	11.0
4	11.4
5	11.9
6	10.8
7	11.1
8	10.5
9	10.4
10	10.1

$$\frac{11.7+10.7+11.0+11.4+11.9+10.8+11.1+11.1+10.5+10.8+10.1}{10}$$

= 11 → mean

$$\text{Std dev} = \sqrt{\frac{\sum_{n=1}^{n=1}(x_i - \bar{x})^2}{(n-1)}}$$

$$\sqrt{\frac{(.7)^2+(.3)^2+(0)^2+(.4)^2+(.9)^2+(.2)^2+(.1)^2+(.5)^2+(.2)^2+(.9)^2}{(n-1)}}$$

$$\sqrt{\frac{.49+.09+0+0.16+0.81+.04+.01+.25+.04+.81}{9}}$$

= 0.6 → Std dev