Name: _____ Date: _____

Block: _____

Uncertainty

(Giancoli 1.4)

Uncertainty: 8.8 cm has an estimated uncertainty of 0.1 cm in the measurement (one of the smallest fraction of the unit.)

8.8 ± 0.1 cm

Percent Uncertainty: The ratio of the uncertainty to the measured value.

$$\frac{0.1}{8.8} X 100\% \approx \mathbf{1\%}$$

8.8 cm ± 1%

Calculations with Percent Uncertainty:

To make calculations with uncertainty, you calculate first using the specified value, and second with the extreme value.

Ex: What is the area A of a circle of radius 12 m? What is the approximate uncertainty on the calculated area?

1. **Area (Specified)**: $A_{Specified} = \pi r^2 = \pi(12\ m)^2 = 452\ m^2$
2. **Uncertainty**: 12 **± 1** m (can be as low as 11 m or as high as 13 m)
3. **Area (Max):** $A_{\max} = \pi r^2 = \pi(13\ m)^2 = 531\ m^2$
4. **Uncertainty on area:** $\Delta A = A_{\max} - A_{Specified}$

   = 531 m^2 – 452 m^2 = **79 m^2**
5. **Percent Uncertainty:** $\frac{\Delta A}{A_{Specified}} X 100\% = \frac{79\ m^2}{452\ m^2} X 100\%$ **= 17%**

Your answer (area or the circle): **452 m^2 ± 17%**

1. Write the following measurements with their uncertainty (Ex**: 6.4 ± 0.1 cm**).
   a) 1.67 m _____
   b) 145 g _____
   c) 12.004 kg _____
   d) 1030 km _____

2. Write the following measurements with their percent uncertainty. Round the percentage to a whole number. (Ex: **4.32 m ± 2%**)
   a) 1.67 m _____
   b) 155 ± 5 g _____
   c) 2000 ± 100 km _____
   d) 100.0 kg ± 0.1 kg _____

3. Calculate the area, and the percent uncertainty, of a circle of radius 1.3×10^2 cm?

   _____ (**53092 cm^2 ± 16%**)

4. Calculate the volume, and the percent uncertainty, of a spherical beach ball whose radius is r = 3.86 ± 0.08 m?

   _____ (**241 m^3 ±6%**)