

Phys 191 – Uncertainty Worksheet

- Convert the following to relative uncertainties:
 - $2.70 \pm 0.05 \text{ cm}$
 - $12.02 \pm 0.08 \text{ cm}$
- Convert the following to absolute uncertainties:
 - $3.5 \text{ cm} \pm 10 \%$
 - $16 \text{ s} \pm 8 \%$
- Complete the following, determining the appropriate uncertainty:
 - $(2.70 \pm 0.05 \text{ cm}) + (12.02 \pm 0.08 \text{ cm})$
 - $(2.70 \pm 0.05 \text{ cm}) - (12.02 \pm 0.08 \text{ cm})$
 - $(2.70 \pm 0.05 \text{ cm}) + (3.5 \text{ cm} \pm 10 \%)$
- Complete the following, determining the appropriate uncertainty:
 - $(2.70 \pm 0.05 \text{ cm}) \times (12.02 \pm 0.08 \text{ cm})$
 - $(12.02 \pm 0.08 \text{ cm}) \div (16 \text{ s} \pm 8 \%)$
 - $(3.5 \text{ cm} \pm 10 \%) \times (2.70 \pm 0.05 \text{ cm}) \div (16 \text{ s} \pm 8 \%)$
- Complete the following, determining the appropriate uncertainty:
 - $2 \times (2.70 \pm 0.05 \text{ cm})$
 - $2 \times (16 \text{ s} \pm 8 \%)$
 - $(12.02 \pm 0.08 \text{ cm})^2$

6. Complete the following determining the appropriate uncertainty:

a. $(12.02 \pm 0.08 \text{ cm})^2 \div (3.5 \text{ cm} \pm 10 \%)$

b. $(12.02 \pm 0.08 \text{ cm})^2 + (3.5 \text{ cm} \pm 10 \%) \times (2.70 \pm 0.05 \text{ cm})$

c. $[(3.5 \text{ cm} \pm 10\%) + (2.70 \pm 0.05 \text{ cm})] / (16 \text{ s} \pm 8\%)$

d. $4\pi^2 / (0.034 \pm 0.004 \text{ s}^2/\text{cm})$

7. Determine the perimeter and area of a rectangle of length $9.2 \pm 0.05 \text{ cm}$ and width $4.33 \pm 0.01 \text{ cm}$.

Answers

- $2.70 \text{ cm} \pm 2 \%$
 - $12.02 \text{ cm} \pm 0.7 \%$
- $3.5 \pm 0.4 \text{ cm}$
 - $16 \pm 1 \text{ s}$
- $14.7 \pm 0.1 \text{ cm}$ (or $14.72 \pm 0.13 \text{ cm}$)
 - $-9.3 \pm 0.1 \text{ cm}$ (or $-9.32 \pm 0.13 \text{ cm}$)
 - $6.2 \pm 0.5 \text{ cm}$ (can be $\pm 0.4 \text{ cm}$ if you used $3.5 \pm 0.35 \text{ cm}$ before rounding)
- $32.5 \text{ cm}^2 \pm 3\% = 32.5 \pm 0.975 \text{ cm}^2 = 33 \pm 1 \text{ cm}^2$
 - $0.75 \text{ cm/s} \pm 9\% = 0.75 \pm 0.07 \text{ cm/s}$
 - $0.59 \text{ cm}^2/\text{s} \pm 20\% = 0.59 \pm 0.12 \text{ cm}^2/\text{s} = 0.6 \pm 0.1 \text{ cm}^2/\text{s}$
- $5.4 \pm 0.1 \text{ cm}$ (or $5.40 \pm 0.10 \text{ cm}$)
 - $32 \text{ s} \pm 8 \% = 32 \pm 2 \text{ s}$
 - $144.5 \text{ cm}^2 \pm 1\% = 144.5 \pm 2 \text{ cm}^2 = 145 \pm 2 \text{ cm}^2$ (may only get ± 1 depending on round-off errors)
- $41 \text{ cm}^2 \pm 10\% = 41 \pm 4 \text{ cm}^2$
 - $154 \pm 3 \text{ cm}^2$ (note that here I am rounding the number 154 to the same precision as the uncertainty, rather than using our usual sigfig rules)
 - I'll accept either $0.39 \text{ cm/s} \pm 15\%$ or $0.39 \text{ cm/s} \pm 20\%$, and if you convert to absolute, you'll get either $0.39 \pm 0.06 \text{ cm/s}$ or $0.39 \pm 0.08 \text{ cm/s}$, depending on when you did your rounding.
 - $1161.13 \text{ cm/s}^2 \pm 10 \% = 1200 \pm 100 \text{ cm/s}^2$
- $P = 27.1 \pm 0.1 \text{ cm}$
 $A = 39.8 \text{ cm}^2 \pm 0.8 \% = 39.8 \pm 0.3 \text{ cm}^2$ (again, use precision of uncertainty to decide on precision of answer)