Phys 191 – Uncertainty Worksheet

1. Convert the following to relative uncertainties:
   a. 2.70 ± 0.05 cm
   b. 12.02 ± 0.08 cm

2. Convert the following to absolute uncertainties:
   a. 3.5 cm ± 10 %
   b. 16 s ± 8 %

3. Complete the following, determining the appropriate uncertainty:
   a. (2.70 ± 0.05 cm) + (12.02 ± 0.08 cm)

   b. (2.70 ± 0.05 cm) – (12.02 ± 0.08 cm)

   c. (2.70 ± 0.05 cm) + (3.5 cm ± 10 %)

4. Complete the following, determining the appropriate uncertainty:
   a. (2.70 ± 0.05 cm) × (12.02 ± 0.08 cm)

   b. (12.02 ± 0.08 cm) ÷ (16 s ± 8 %)

   c. (3.5 cm ± 10 %) × (2.70 ± 0.05 cm) ÷ (16 s ± 8 %)

5. Complete the following, determining the appropriate uncertainty:
   a. 2 × (2.70 ± 0.05 cm)

   b. 2 × (16 s ± 8 %)

   c. $(12.02 \pm 0.08 \text{ cm})^2$

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 ± 0.05 cm and width 4.33 ± 0.01 cm.

Answers

1. a. 2.70 cm ± 2 %
   b. 12.02 cm ± 0.7 %

2. a. 3.5 ± 0.4 cm
   b. 16 ± 1 s

3. a. 14.7 ± 0.1 cm (or 14.72 ± 0.13 cm)
   b. −9.3 ± 0.1 cm (or −9.32 ± 0.13 cm)
   c. 6.2 ± 0.5 cm (can be ± 0.4 cm if you used 3.5 ± 0.35 cm before rounding)

4. a. 32.5 cm^2 ± 3% = 32.5 ± 0.975 cm^2 = 33 ± 1 cm^2
   b. 0.75 cm/s ± 9% = 0.75 ± 0.07 cm/s
   c. 0.59 cm^2/s ± 20% = 0.59 ± 0.12 cm^2/s = 0.6 ± 0.1 cm^2/s

5. a. 5.4 ± 0.1 cm (or 5.40 ± 0.10 cm)
   b. 32 s ± 8 % = 32 ± 2 s
   c. 144.5 cm^2 ± 1% = 144.5 ± 2 cm^2 = 145 ± 2 cm^2 (may only get ± 1 depending on round-off errors)

6. a. 41 cm^2 ± 10% = 41 ± 4 cm^2
   b. 154 ± 3 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)
   c. I'll accept either 0.39 cm/s ± 15% or 0.39 cm/s ± 20%, and if you convert to absolute, you'll get either 0.39 ± 0.06 cm/s or 0.39 ± 0.08 cm/s, depending on when you did your rounding.
   d. 1161.13 cm/s^2 ± 10 % = 1200 ± 100 cm/s^2

7. P = 27.1 ± 0.1 cm
   A = 39.8 cm^2 ± 0.8 % = 39.8 ± 0.3 cm^2 (again, use precision of uncertainty to decide on precision of answer)