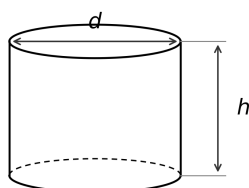


0. Uncertainties and Vectors

0.2 Uncertainties

12. A student measures the length L of the side of a cube with an absolute uncertainty ΔL . What is the fractional uncertainty in the total surface area of the cube?
A. $2\Delta L/L$ B. $\Delta L/L$ C. $(\Delta L/L)^2$ D. $6(\Delta L/L)^2$
13. The density of a solid is determined from the equation $\rho = m / V$. The measurement of the mass m has an uncertainty of 2 % and the measurement of the volume V has an uncertainty of 5 %. What is the uncertainty in the density of the solid?
A. 7 % B. 2.5 % C. 3 % D. 10 %
14. An object of mass 2.0 kg moves with a speed of $8.0 \pm 0.4 \text{ m s}^{-1}$. Its kinetic energy is calculated to be 64 J using $E = \frac{1}{2}mv^2$. The uncertainty in the mass is negligible. What is the absolute uncertainty in E ?
A. $\pm 0.4 \text{ J}$ B. $\pm 3 \text{ J}$ C. $\pm 6 \text{ J}$ D. $\pm 13 \text{ J}$
15. The diameter of a wire is measured with an uncertainty of 3 %. What is the uncertainty in the cross-sectional area of the wire?
A. 3 % B. 6 % C. 9 % D. 12 %
16. A body of mass m moves with a speed v . The uncertainty in m is 3 % and the uncertainty in v is 6 %. $p = mv$. The uncertainty in the momentum p is
A. 2 % B. 3 % C. 9 % D. 18 %
17. The kinetic energy E of a body of mass m moving with speed v is given by $E = \frac{1}{2}mv^2$. The kinetic energy is determined with an uncertainty of 9 % and the mass is measured with an uncertainty of 3 %. What is the uncertainty in the speed of the body?
A. 2 % B. 3 % C. 6 % D. 12 %
18. The diameter d and the height h of a solid cylinder are each measured to be $4.00 \pm 0.05 \text{ cm}$.



One student calculates the curved surface area $A = \pi dh$. Another student calculates the volume $V = \pi d^2 h / 4$. How does the percentage uncertainty in V compare with the percentage uncertainty in A ?

- A. 1.5 times as large B. the same
C. 2 times as large D. 0.5 times as large
19. The length l of a simple pendulum has a percentage uncertainty of 3 % and the acceleration of free fall g has a percentage uncertainty of 5 %. The period T of the pendulum is given by $T = 2\pi\sqrt{l / g}$. What is the percentage uncertainty in T ?

0. Uncertainties and Vectors

- A. 2 % B. 4 % C. 8 % D. 16 %
20. The uncertainty in the mass M of a uniform wire is 2 %, the uncertainty in its diameter D is 3 % and the uncertainty in its length L is 1 %. The density ρ of the wire is determined by the relationship $\rho = 4M / (\pi D^2 L)$. What is the uncertainty in ρ ?
- A. 6 % B. 8 % C. 9 % D. 12 %
21. The sides of a square are measured to be 4.0 ± 0.1 cm. Which of the following gives the area of the square and its uncertainty?
- A. 16.0 ± 0.1 cm² B. 16.0 ± 0.2 cm²
C. 16.0 ± 0.8 cm² D. 16 ± 2 cm²
22. The length of the side of a cube is 6.0 ± 0.2 cm. What is the uncertainty in the volume of the cube?
- A. ± 0.008 cm³ B. ± 0.6 cm³ C. ± 7 cm³ D. ± 22 cm³
23. A digital voltmeter with a resolution of 0.01 V shows a reading of 2.50 V for the potential difference across a resistor of known resistance R . The power dissipated is calculated using $P = V^2 / R$. The uncertainty in R is negligible. What is the percentage uncertainty in the calculated power?
- A. 0.4 % B. 0.8 % C. 1.6 % D. 4 %
24. A rectangular metal block has dimensions 50 mm $\times$ 20 mm $\times$ 10 mm. Each dimension is measured with a ruler that has an uncertainty of ± 1 mm. What is the absolute uncertainty in the volume of the block?
- A. ± 3 mm³ B. ± 170 mm³ C. ± 1700 mm³ D. ± 3000 mm³
25. A student finds the mass of the water in a beaker by weighing the beaker when full and again when empty. The two readings are 152 ± 1 g and 148 ± 1 g. What is the percentage uncertainty in the calculated mass of the water?
- A. 0.7 % B. 1.3 % C. 25 % D. 50 %