

1-4 Dimensional Analysis

21. (I) The kinetic energy of a baseball is denoted by $mv^2/2 = p^2/2m$, where m is the baseball's mass and v is its speed. This relation can be used to define p , the baseball's momentum. Use dimensional analysis to find the dimensions of momentum.

- 22.** (I) One of Einstein's most famous results is contained in the formula $E = mc^2$, where E is the energy content of the mass m , and c is the speed of light. What are the dimensions of E ?
- 23.** (I) A length L that appears in atomic physics is given by the formula $L = h/m_e c$, where m_e is the mass of an electron, c is the speed of light, and h is a constant known as Planck's constant. What are the dimensions of h ?
- 24.** (II) What are the dimensions of $h^2/m^3 G$, where h is a constant called Planck's constant, m is a mass, and G is the gravitational constant? The dimensions of the constants in this formula can be found in the list of physical constants given in Appendix II.
- 25.** (III) A force F acting on a body of mass m a distance r from some origin has magnitude $F = A m e^{-\alpha r}/r^3$, where A and α are both constants. The constant $e = 2.718 \dots$ is Euler's constant. Given that the force has dimensions $\text{kg} \cdot \text{m}/\text{s}^2$, what are the dimensions of (a) the constant α ? (b) the constant A ?