Given: Basic dimensions M, L, t and T.

Find: Dimensional representation of quantities below, and typical units in SI and English systems.

Solution:

(a) $\text{Power} = \dfrac{\text{Energy}}{\text{Time}} = \dfrac{\text{Force} \times \text{Distance}}{\text{Time}}$

From Newton's second law, Force = Mass x Acceleration

$\therefore \text{Power} = \dfrac{\text{Mass} \times \text{Acc.} \times \text{Dist.}}{\text{Time}} = \left[\dfrac{M \frac{L}{t^2} L}{t}\right] = \left[\dfrac{ML^2}{t^3}\right]$; $\dfrac{kg \cdot m^2}{s^3}$ or $\dfrac{slug \cdot ft}{s^3}$

(b) $\text{Pressure} = \dfrac{\text{Force}}{\text{Area}} = \left[\dfrac{F}{L^2}\right] = \left[\dfrac{ML}{t^2}\dfrac{1}{L^2}\right] = \left[\dfrac{M}{Lt^2}\right]$; $\dfrac{kg}{m \cdot s^2}$ or $\dfrac{slug}{ft \cdot s^2}$

(c) $\text{Modulus of elasticity} = \dfrac{\text{Force}}{\text{Area}} = \left[\dfrac{M}{Lt^2}\right]$; $\dfrac{kg}{m \cdot s^2}$ or $\dfrac{slug}{ft \cdot s^2}$

(d) $\text{Angular velocity} = \dfrac{\text{Radians}}{\text{Time}} = \left[\dfrac{1}{t}\right]$; $\dfrac{1}{s}$ or $\dfrac{1}{s}$

(e) $\text{Energy} = \text{Force} \times \text{Distance} = \left[\dfrac{ML}{t^2} L\right] = \left[\dfrac{ML^2}{t^2}\right]$; $\dfrac{kg \cdot m^2}{s^2}$ or $\dfrac{slug \cdot ft^2}{s^2}$

(f) $\text{Momentum} = \text{Mass} \times \text{Velocity} = \left[M \dfrac{L}{t}\right] = \left[\dfrac{ML}{t}\right]$; $\dfrac{kg \cdot m}{s}$ or $\dfrac{slug \cdot ft}{s}$

(g) $\text{Shear stress} = \dfrac{\text{Force}}{\text{Area}} = \left[\dfrac{M}{Lt^2}\right]$; $\dfrac{kg}{m \cdot s^2}$ or $\dfrac{slug}{ft \cdot s^2}$

(h) $\text{Specific heat} = \dfrac{\text{Energy}}{\text{Mass} \times \text{Temperature}} = \left[\dfrac{\frac{ML^2}{t^2}}{M\ T}\right] = \left[\dfrac{L^2}{t^2 T}\right]$; $\dfrac{m^2}{s^2 \cdot K}$ or $\dfrac{ft^2}{s^2 \cdot {}^\circ R}$

(i) $\text{Thermal expansion coefficient} = \dfrac{\text{Change in length / Length}}{\text{Temperature}} = \left[\dfrac{1}{T}\right]$; $\dfrac{1}{K}$ or $\dfrac{1}{{}^\circ R}$