Problem 1: [100 points]

Find the amount of wind energy at 15 °C and 1 atm pressure that passes through 1 m² of cross-sectional area for the following wind regimes:

(Take the air density at 15 °C and 1 atm pressure as 1.225 kg/m³).

(i) [50 points] 100 hours of 6-m/s winds

With 100 h at 6 m/s

Energy (6 m/s) = \( \frac{1}{2} \rho A v^3 \Delta t = \frac{1}{2} (1.225 \text{ kg/m}^3) (1 \text{ m}^2) (6 \text{ m/s})^3 (100 \text{ h}) = 13,230 \text{ Wh} \)

(ii) [50 points] 50 hours at 3 m/s plus 50 hours at 9 m/s (i.e. an average wind speed of 6 m/s)

With 50 h at 3 m/s

Energy (3 m/s) = \( \frac{1}{2} \rho A v^3 \Delta t = \frac{1}{2} (1.225 \text{ kg/m}^3) (1 \text{ m}^2) (3 \text{ m/s})^3 (50 \text{ h}) = 827 \text{ Wh} \)

With 50 h at 9 m/s

Energy (9 m/s) = \( \frac{1}{2} \rho A v^3 \Delta t = \frac{1}{2} (1.225 \text{ kg/m}^3) (1 \text{ m}^2) (9 \text{ m/s})^3 (50 \text{ h}) = 22,326 \text{ Wh} \)

For a total of 827 + 22,326 = 23,153 Wh