

Answer on Question #42195 – Physics - Mechanics | Kinematics | Dynamics

5. The force (not the power) required to tow a boat at constant velocity is proportional to the speed. If a speed of 4.0 km/h requires 7.5 kW power, how much power does a speed of 12 km/h require?

Solution:

$$V_1 = 4.0 \frac{\text{km}}{\text{h}}; P_1 = 7500 \text{ W}$$

$$V_2 = 12 \frac{\text{km}}{\text{h}}; P_2 = ?$$

The force is proportional to the speed (α – coefficient):

$$F = \alpha V \quad (1)$$

Formula for the power:

$$P = \frac{\text{work}}{\text{time}} = \frac{F \cdot S}{t} = F \cdot \frac{S}{t} = F \cdot V \quad (2)$$

(1)in(2):

$$P = \alpha V \cdot V = \alpha V^2$$

In first case:

$$P_1 = \alpha V_1^2 \quad (3)$$

In second case:

$$P_2 = \alpha V_2^2 \quad (4)$$

(4) ÷ (3):

$$\frac{P_2}{P_1} = \frac{\alpha V_2^2}{\alpha V_1^2}$$

$$P_2 = P_1 \frac{V_2^2}{V_1^2} = 7500 \text{ W} \cdot \frac{\left(12 \frac{\text{km}}{\text{h}}\right)^2}{\left(4.0 \frac{\text{km}}{\text{h}}\right)^2} = 68000 \text{ W} = 68 \text{ kW}$$

Answer: a speed of 12 km/h require 68 kW of power.