

Name: _____

Date: _____

Section _____

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The Masters School

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Physics



Power

1. What is the top speed that a boat could travel in rough water, if it has a 200 hp outboard motor, and the water exerts a resistive force of 8300 N?

Cannot accelerate any more

$\therefore$ Constant velocity

$\therefore F_{\text{net } x} = 0$

$F_{\text{net } x} = F_{\text{app } x} - F_K$

$F_{\text{app } x} = F_K$

$$P = F \cdot v$$

$$200 \text{ hp} = F_{\text{app}} \cdot v$$

$$149,200 \text{ W} = F_K \cdot v$$

$$\frac{149,200}{8300} = v = 17.976 \text{ m/s}$$

2. If a V-12, 1700 kg Lamborghini Diablo can accelerate from rest to 60 mph (26.82 m/s) in 3.2 seconds, with an average of $1.8 \times 10^4 \text{ N}$ resistive force, how much horsepower does the Lamborghini Diablo have under the hood?

Given $m = 1700 \text{ kg}$

$$v_i = 0$$

$$v_f = 26.82 \text{ m/s}$$

$$\Delta t = 3.2 \text{ s}$$

$$F_K = 1.8 \times 10^4 \text{ N}$$

$$P = ?$$

$$P = \frac{W}{\Delta t}$$

$$P = \frac{F \cdot d}{\Delta t}$$

$$P = \frac{F \cdot \Delta x}{\Delta t}$$

$$P = F \cdot v$$

Find Δx

$$\Delta x = \frac{1}{2} (v_i + v_f) \Delta t$$

$$\Delta x = \frac{1}{2} (0 + 26.82)(3.2)$$

$$\Delta x = 42.912 \text{ m}$$

Find F (F_{app})

$$F_{\text{net } x} = F_{\text{app}} - F_K$$

$$M \cdot a = F_{\text{app}} - 1.8 \times 10^4 \text{ N}$$

$$(1700)(8.38) + 1.8 \times 10^4 = F_{\text{app}}$$

$$32,248 \text{ N} = F_{\text{app}}$$

$$P = \frac{F \Delta x}{\Delta t}$$

$$P = \frac{(32,248)(42.912)}{(3.2)}$$

$$P = 432,447 \text{ W}$$

$$P = 580 \text{ HP}$$

$$v_f = v_i + a \Delta t$$

$$a = \frac{26.82}{3.2} = 8.38 \text{ m/s}^2$$

For wakeboarding enthusiasts who may not have a boat, they have to resort to something called a *winch*, which is a makeshift tow rope that can pull a wake boarder by engine power alone. The best winch around is called "The Grinch Winch" (give it a search on Youtube), a 7 hp winch with 600 m tow rope.

<http://www.youtube.com/watch?v=Fku-yUkkX6M&feature=related>

- a. How fast would you be riding if you were pulled by the winch with a 400 N force?

$$F_{app} = 400 \text{ N}$$

$$P = 7 \text{ hp}$$

$$P = 5222 \text{ W}$$

$$P = F \cdot V$$

$$V = \frac{P}{F} = \frac{5222}{400}$$

$$V = 13.05 \text{ m/s}$$

- b. How long would the ride be?

Length of tow rope is 600 m

$$\Delta x = 600 \text{ m}$$

$$V = 13.06 \text{ m/s}$$

$$V = \frac{\Delta x}{\Delta t}$$

$$\Delta t = \frac{\Delta x}{V} = \frac{600}{13.06}$$

$$\Delta t = 45.94 \text{ sec}$$