Dief Gerard

Boat weight $W = 64000\,lb$
Propeller Force $F_p = 50\,000\,lb$
$K = 2000\,lb\text{-}s/ft$

Since they say that the manitude of the water's force is proportinal to the boat's speed (velocity)
Thus:

$$F_R = K \cdot V = 2000V$$

Resistive force

We will need to find the mass of the boat:

$$W = m \times g$$

$$m = \frac{W}{g} = \frac{64000}{32} = 2000\,lb$$

Let's find the total or Net force acting on the boat:

$$F = F_p - F_R$$

$$F = 50\,000 - 2000V$$

We also know that: $F = ma$

$$a = V'$$

For $F = F$ we get: $50000 - 2000V = 2000V'$

solving for V':

$$\frac{50\,000}{2000} - \frac{2000V}{2000} = V'$$

$$25 - V = V'$$

$$\frac{dV}{dt} = -(V - 25)$$

$$\frac{dV}{V - 25} = -dt$$

$$\int \frac{dV}{V - 25} = \int -dt$$

$$\log|V - 25| = -t + c$$

$V - 25 = ce^{-t}$
$V = ce^{-t} + 25$

The boat started from rest. So: $V(0) = 0$

$V(0) = c + 25$
$0 - 25 = c$
$c = -25$

$\boxed{\text{Thus: } V = -25e^{-t} + 25 \text{ ft/s} \quad \text{or} \quad V = 25(-e^{-t} + 1) \text{ ft/s}}$

Considere the terminal velocity to be the maximum with $v = 25(-e^{-t}+1)$

$V' = 25\left(\frac{d(-e^{-t})}{dt} + \frac{d1}{dt}\right)$
$V' = 25(e^{-t} + 0)$
$V' = 25e^{-t}$

$V'' = -25e^{-t}$

We can conlude that V is increasing for $V' = 25e^{-t} > 0$ and $V'' < 0$

Therefore the boat would approach its maximum speed as $t \to \infty$

Thus: Max Velocity =
$V_{max} = \lim_{t\to\infty} 25(1 - e^{-t})$

$V_{max} = 25(1 - \lim_{t\to\infty} e^{-t})$

$V_{max} = 25(1 - 0)$
$V_{max} = 25$ ft/s

$\boxed{V_{Terminal} = V_{max} = 25 \text{ ft/s}}$