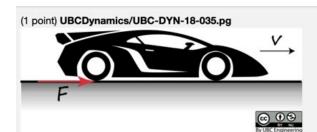# UBC-DYN-18-035

Assume that the engine of a car is providing $82\ kW$. If the initial velocity of the car is $15\ m/s$, find the velocity of the car when it travels $100\ m$. The mass of the car is $1000\ kg$.

$v_f = \boxed{}\ m/s$

$$P = F \cdot v \quad (\text{same direction}) \quad \therefore \text{ accel. } \underline{\text{not}} \text{ constant}$$
$$\underset{\text{constant}}{=} \qquad \underset{\text{non-const.}}{\nwarrow} \qquad \qquad (\text{since F not constant})$$

$$ads = v\,dv \qquad\qquad \Sigma F_x: \ F = ma$$

$$\frac{F}{m}ds = v\,dv \qquad\qquad \Rightarrow a = \frac{F}{m}$$

$$\times v: \quad \frac{F \cdot v}{m}ds = v^2\,dv$$

$$\Rightarrow \frac{P}{m}ds = v^2\,dv$$

$$\int_{s_1}^{s_2} \frac{P}{m}ds = \int_{v_1}^{v_2} v^2\,dv \ \Rightarrow\ \frac{P}{m}(s_2 - \cancelto{0}{s_1}) = \frac{v^3}{3}\Big|_{v_1}^{v_2}$$

$$= \frac{1}{3}v_2^3 - \frac{1}{3}v_1^3$$

$$\Rightarrow v_2 = \left(\frac{3Ps_2}{m} + v_1^3\right)^{1/3}$$