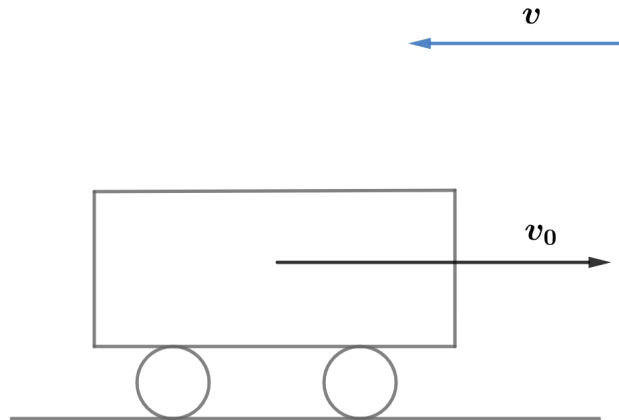


2020A F=ma Exam: Problem 20

Kevin S. Huang



Recall the power output of the car is satisfies

$$P = Fv_0$$

In our case,

$$F = Av_{\text{rel}}^2 = A(v_0 + v_w)^2$$
$$P = Av_0(v_0 + v_w)^2$$

Taking the time average,

$$\bar{P} = Av_0\langle v_0^2 + 2v_0v_w + v_w^2 \rangle = Av_0(v_0^2 + 2v_0\langle v_w \rangle + \langle v_w^2 \rangle)$$

Since $\langle v_w^2 \rangle > \langle v_w \rangle^2$ by definition of the standard deviation and $v = \langle v_w \rangle$,

$$\bar{P} > Av_0(v_0^2 + 2v_0\langle v_w \rangle + \langle v_w \rangle^2) = Av_0(v_0 + \langle v_w \rangle)^2$$
$$\bar{P} > Av_0(v_0 + v)^2$$

so the answer is B.