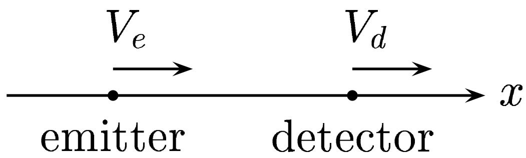
Consider the case, where both the emitter and the detector are moving along the positive x direction. See sketch. The frequency emitted by the emitter is f_0. The speeds of the detector and the emitter are respectively, $v_d = 0.4\, v_s$, and $v_e = 0.2\, v_s$.



Determine $v_{detected}$, the speed which wave fronts of sound waves cross the detector and $\lambda_{detected}$, the wavelength of sound waves as detected by the detector.

A) $v_{detected} = v_s + v_d$ and $\lambda_{detected} = \dfrac{v_s + v_e}{f_0}$.

B) $v_{detected} = v_s + v_d$ and $\lambda_{detected} = \dfrac{v_s - v_e}{f_0}$.

C) $v_{detected} = v_s - v_d$ and $\lambda_{detected} = \dfrac{v_s + v_e}{f_0}$.

D) $v_{detected} = v_s - v_d$ and $\lambda_{detected} = \dfrac{v_s - v_e}{f_0}$.

The detector is moving away from the sound waves.
So $v_{detected} = v_s - v_d$.
The emitter is moving toward the detector.
So the detected wavelength is shortened,*i.e*,

$$\lambda_{detected} = \lambda_0 - v_e\, T = \frac{v_s - v_e}{f_0}.$$

Answer **A**