

75. (a) With the detector stationary, we seek a value of source speed  $v_S$  such that the frequency ratio (heard/emitted) is  $r = (20 \text{ kHz})/(30 \text{ kHz}) = 2/3$ . From the Doppler effect formula, we find

$$f' = f \left( \frac{v + 0}{v + v_S} \right) \implies v_S = \left( \frac{1 - r}{r} \right) v .$$

If  $v = 343 \text{ m/s}$ , we get  $v_S = 171.5 \text{ m/s}$  which converts to  $617 \text{ km/h}$ .

- (b) If  $r = 20/22$ , we find  $v_S = 34.3 \text{ m/s} = 123 \text{ km/h}$ .