Sonic Doppler effect

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Solution: *a. The pendulum's oscillation frequency is,*

$$\omega = \sqrt{\frac{g}{L}} = 2\pi \cdot 0.5 \ Hz \ .$$

b. The energy of the oscillation is,

$$E_{cin} + E_{pot} = \tfrac{m}{2}v^2 + mg(L - L\cos\theta) = \tfrac{m}{2}v_m^2 = mg(L - L\cos\theta_m) = 0.149 \ J \ .$$

c. Therefore, the maximum speed of the speaker is,

$$v_m = \sqrt{2gL(1 - \cos\theta_m)} = 54.6 \ cm/s \ .$$

d. The speed of sound being $v_s = 340 \ m/s$, the minimum and maximum sound frequencies are,

$$\nu_r = \nu_f \frac{v_s}{v_s \pm v_m} = 440 \ Hz \ \frac{340}{340 \pm 0.3} = 439.3 \ (440.7) \ m/s \ .$$