A man marries a great Wagnerian soprano but alas, he discovers he cannot stand Wagnerian opera. In order to save his eardrums, the unhappy man decides he must silence his lark-like wife for good. His plan is to tie her to the front of his car and send car and soprano speeding towards a brick wall. This soprano, however is quite shrewd, having studied physics in her student days at the music conservatory. She realizes that this wall has a resonant frequency of 600 Hz, which means that if a continuous sound wave of this frequency hits the wall, it will fall down, and she will be saved to sing again. The car is heading toward the wall at a high speed of 30 m/s.

a) At what frequency must the soprano sing so that the wall will crumble?

b) What frequency will the soprano hear reflected from the wall just before it crumbles?

a) The wall serves as the listener so let $f_L = 600\,\text{Hz}$

$$f_S = \left(\frac{|\vec{v} - \vec{v}_S|}{|\vec{v} - \vec{v}_L|} \right) f_L$$

$$\vec{v}_L = 0,\ \vec{v}_S = 30\ \text{m/s},\ \ \vec{v} = 344\ \text{m/s}$$

$$f_S = 548\ \text{Hz}$$

b) Now the wall serves as a stationary source with $f_s = 600\,\text{Hz}$

$$f_L = \left(\frac{|\vec{v} - \vec{v}_L|}{|\vec{v} - \vec{v}_S|} \right) f_S$$

$$\vec{v}_S = 0, \quad \vec{v}_L = -30\ \text{m/s}, \quad \vec{v} = 344\ \text{m/s}$$

$$f_L = 652\,\text{Hz}$$