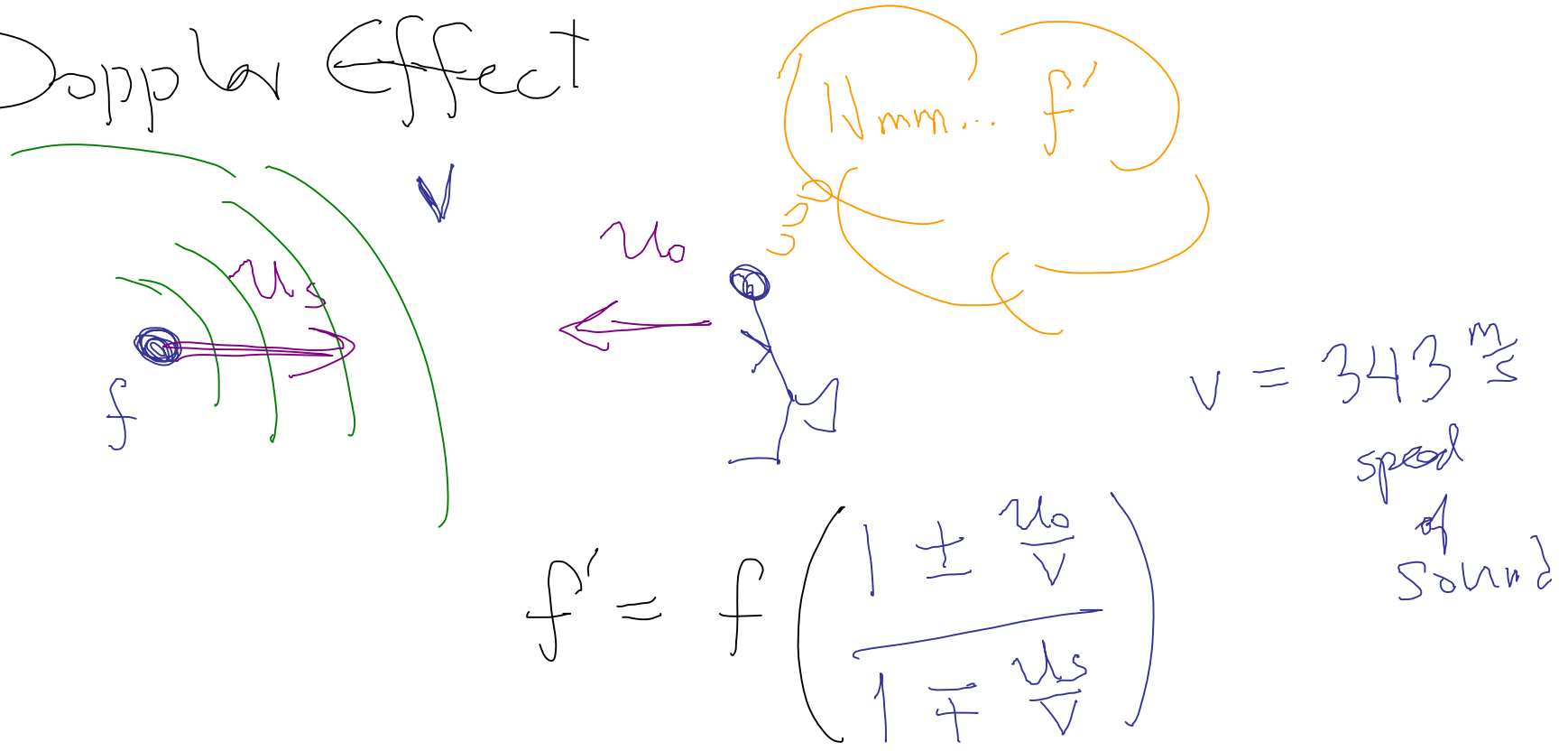
Phys 2110-4 4/23/12

Note Title 4/23/2012

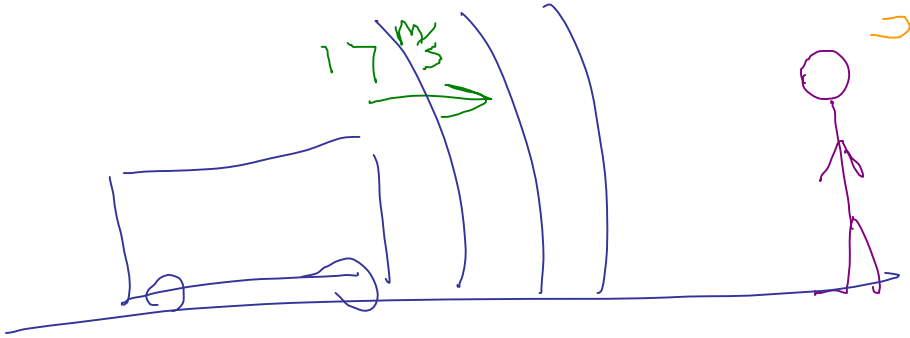
Doppler Effect



$$f' = f\left(\frac{1 \pm \frac{v_o}{v}}{1 \mp \frac{v_s}{v}}\right)$$

$v = 343 \frac{m}{s}$ speed of sound

14.44 A car horn emits 780 Hz sound. Car moves at 17 m/s with horn blasting. What will person standing in front hear?



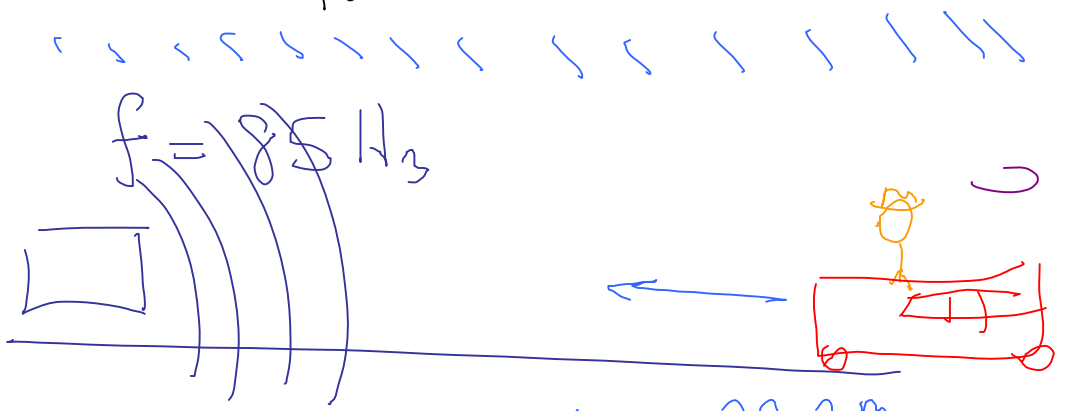
$f = 780$

$$f' = f\left(\frac{1}{1 - \frac{17\ m/s}{343\ m/s}}\right)$$

780 Hz

$f' = 821$ Hz

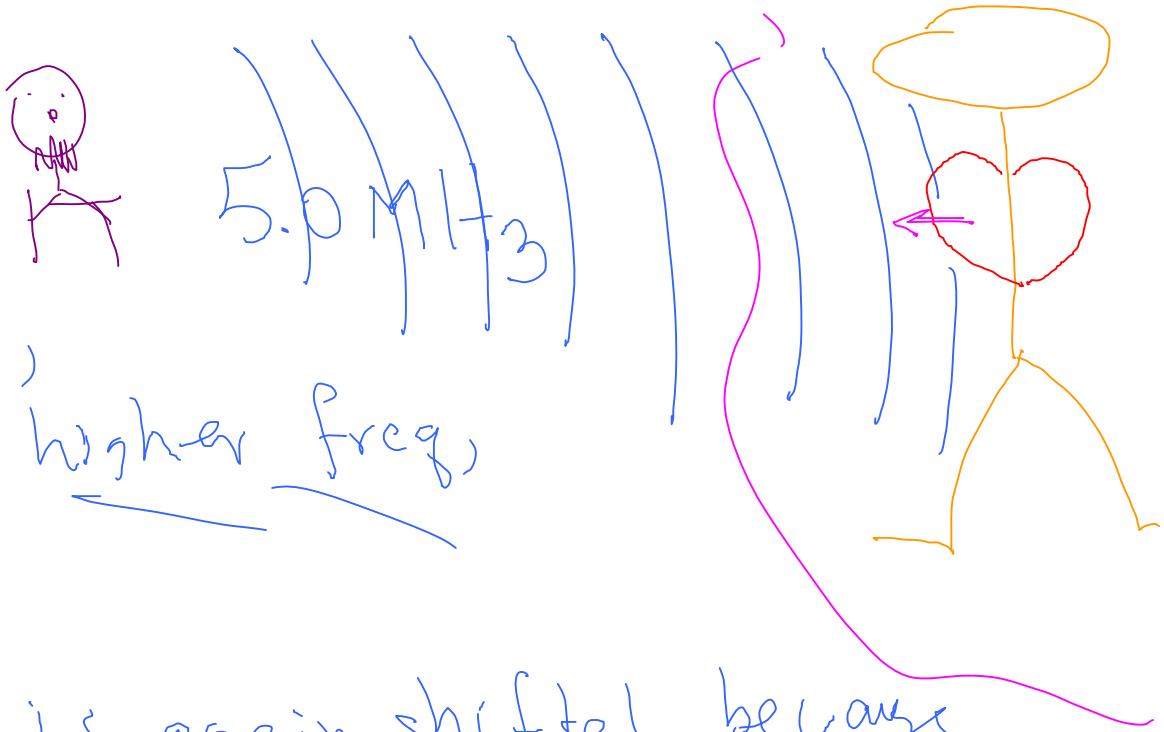
14.45 Stationary siren on fire house blares at 85 Hz. What' freq perceived by firefighters racing toward station at 120 $\frac{km}{hr}$



$$f' = f\left(1 + \frac{33.3 \frac{m}{s}}{343 \frac{m}{s}}\right)$$

$$= 93.1 \text{ Hz}$$

14.78



Wave hit wall,

Wall "hears" higher freq,

v_0

Echo's wave is again shifted because now wall is moving source, v_s

$\Longrightarrow$ v Freq Heard" $= f\left(1+\frac{v}{v}\right) = f'$

Echo'd freq:

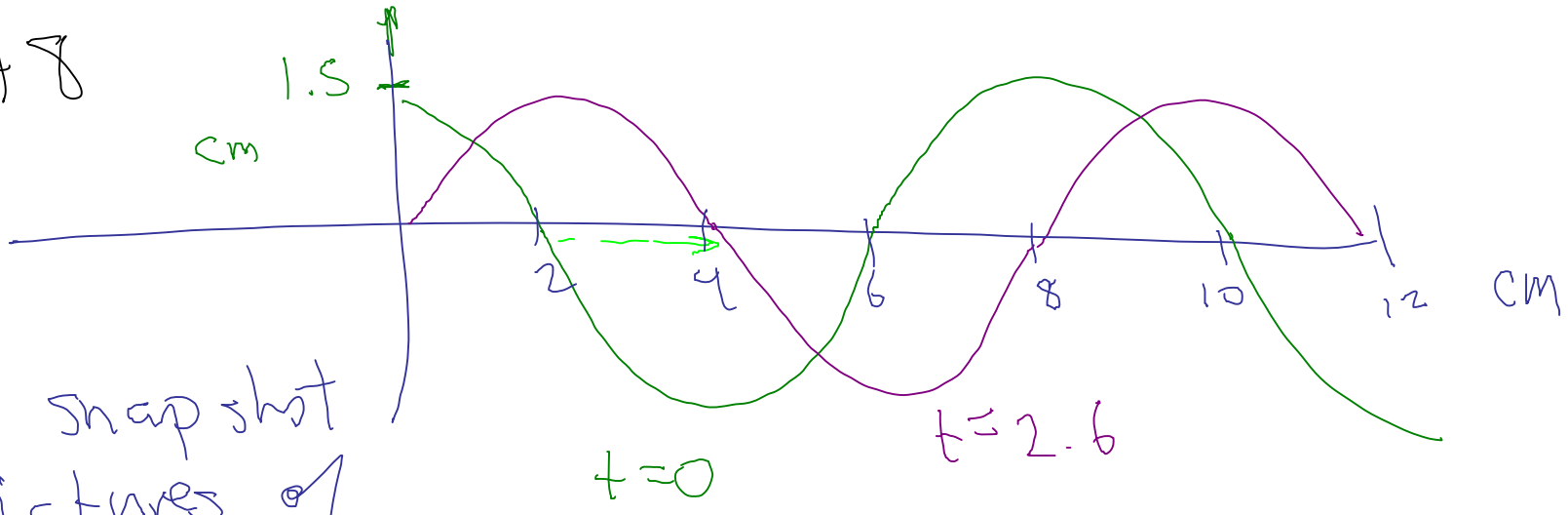
$$f'' = f'\left(\frac{1}{1-v_s/v}\right) = f\left(\frac{1+v_s/v}{1-v_s/v}\right)$$

$$f = 5.0\ \text{mHz}$$

$$f'' = 5.0\ \text{mHz} + 120\ \text{Hz}$$

Let $x = v_s/v$ $\qquad f'' = f\left(\frac{1+x}{1-x}\right)$

14.48



Two snapshot pictures of wave. Write a mathematical descrip of wave.

$$y(x,t) = A\cos(kx \mp \omega t + \phi)$$

− right

+ left

$$\lambda = 8.0\ \text{cm} \qquad k = \frac{2\pi}{\lambda} = 0.785\ \text{cm}^{-1}$$

$$v = \frac{\omega}{k} \qquad \omega = kv$$

$$v = \frac{2.0\,\text{cm}}{2.6\,\text{s}} \qquad \omega = (0.785\,\text{cm}^{-1})v$$

$$= 0.604\,\text{s}^{-1}$$

$$A = 1.5\,\text{cm}$$

$$y(x,t) = (1.5\,\text{cm})\cos\left[(0.785\,\text{cm}^{-1})x - (0.604\,\text{s}^{-1})t\right]$$

14.64 What are the intensities in W/m^2 of sounds with intensities

a) 65 dB (b) −5 dB

$$\beta = 10 \log_{10}\left(\frac{I}{I_0}\right) \qquad I_0 = 10^{-12}\ \frac{W}{m^2}$$

$$= 65$$

$$\log_{10}\left(\frac{I}{I_0}\right) = \frac{65}{10} = 6.5 \qquad \left(\frac{I}{I_0}\right) = 10^{6.5}$$

$$I = I_0 10^{6.8} = 3.2 \times 10^{-6}\ \frac{W}{m^2}$$

14.67 Two distances