1. a)

$$y(x,t) = A\sin\left(\frac{2\pi}{\lambda}(x - vt)\right)$$

$$\lambda = \frac{2\pi}{k} = \frac{2\pi}{4\pi\ m^{-1}} = 0.5\ m$$

b)

$$f = \frac{v}{\lambda} = \frac{4\ m/s}{0.5\ m} = 8\ Hz$$

c)

$v = 4\ m/s$ in the positive x direction

2. a)

$$\lambda = 4L = (4)(2.4\ m) = 9.6\ m$$

$$f = \frac{v}{\lambda} = \frac{343\ m/s}{9.6\ m} = 35.7\ Hz$$

b)

The beat produced is at 0.7 Hz, so $f_{beat} = 0.7\ Hz = |f_{organ} - f_{fork}|$

$$f_{organ} = f_{fork} \pm 0.7\ Hz = 391.3\ Hz\ \boldsymbol{or}\ 392.7\ Hz$$

Dividing these by the fundamental frequency of the organ we get $n = 10.96$ and $n = 11$

So the beat is caused by the 11th harmonic of the organ

3. The car emits the sound traveling at v = 24 km/h = 6.67 m/s towards the wall. It is then reflected back towards the car, so the shift is:

$$f = \left(\frac{c + v_r}{c + v_s}\right) f_0$$

$$f = \left(\frac{(343 + 6.67)\ m/s}{(343 - 6.67)\ m/s}\right)(250\ Hz) = 259.9\ Hz$$

So the beat frequency is $259.9\ Hz - 250\ Hz = 9.9\ Hz$

4. a) The background + computer is at 50 dB and the background is at 40 dB. 10 dB difference -> ratio of 10x

b) The headphones are at 85 dB and the background + computer is at 50 dB. 35 dB difference so

$$35\ dB = 10\log\left(\frac{I_{headphones}}{I_{computer}}\right)$$

$$\frac{I_{headphones}}{I_{computer}} = 10^{3.5} = 3162$$