Wave numbers for HF and HCl

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Solution: You will need to use the reduced mass for each molecule. Using the fact that

$$\tilde{\nu} = \frac{1}{2\pi c}\sqrt{\frac{k}{\mu}}$$

.

You need to calculate the force constant,

$$k = 4\pi^2 \mu c^2 \tilde{\nu}^2$$

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For HCl we have

$$\mu = \frac{m_1 m_2}{m_1 + m_2} = \frac{(1)(35.45)}{1 + 35.45} = 0.972\ amu$$

and for HF we have

$$\mu = \frac{m_1 m_2}{m_1 + m_2} = \frac{(1)(19)}{1+19} = 0.95\ amu$$

870 N/m

Force constants for HF and HCl

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Inserting these values we find
for HCl

$$\mathrm{k} = 4\pi^2(0.972)(1.66\,x10^{-27})(2.99\,x10^{10})^2(2940)^2$$

$$\mathrm{k} = 492\,\frac{N}{m}$$

for HF

$$k = 4\pi^2(0.95)(1.66\,x10^{-27})(2.99\,x10^{10})^2(3910)^2$$

$$\mathrm{k} = 850\,\frac{N}{m}$$