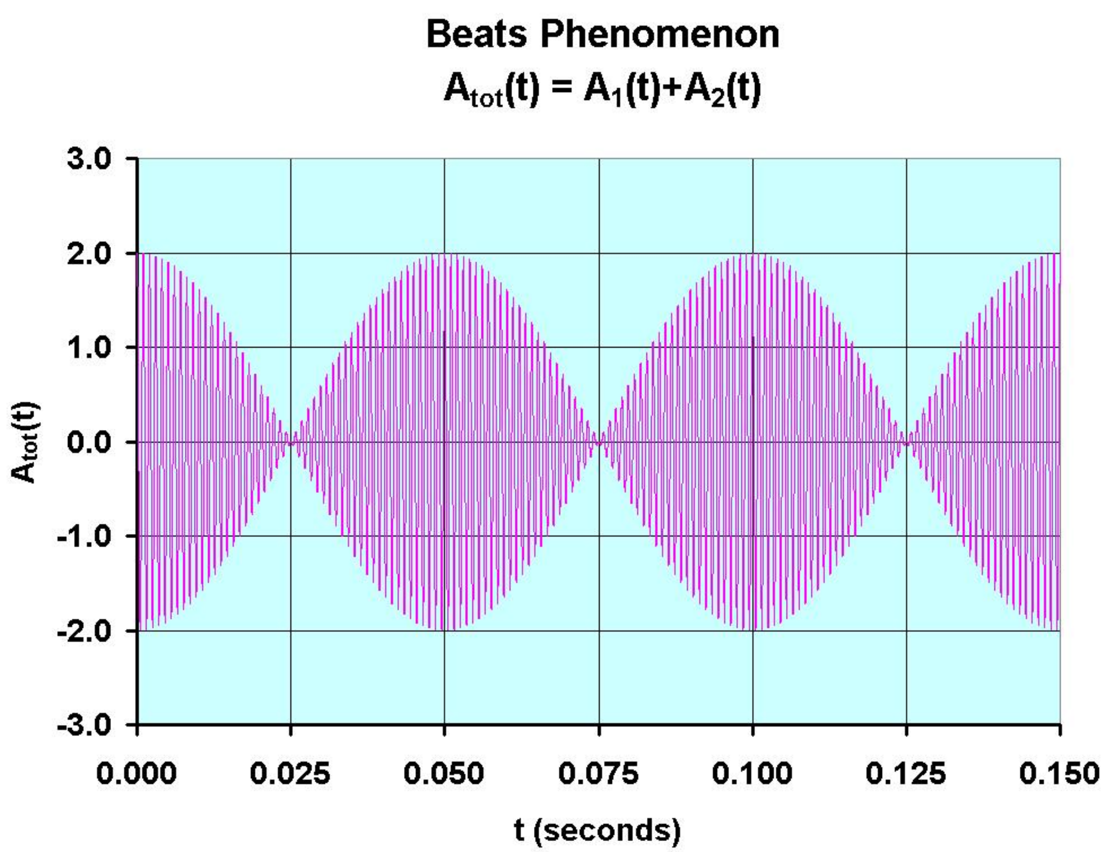
The phase of the total amplitude $A_{tot}(t)$ relative to that of the first amplitude $A_1(t)$, at an arbitrary time t is $\Delta\psi(t)$ and is obtained from the projections of the total amplitude phasor $A_{tot}(t)$ onto the y- and x- axes of the 2-D phasor plane:

$$\tan\Delta\psi = \frac{A_2(t)\cos\left(\omega_2(t)t + \Delta\varphi_{21}(t)\right)\sin\Delta\varphi_{21}(t)}{A_1(t)\cos\left(\omega_1(t)t\right) + A_2(t)\cos\left(\omega_2(t)t + \Delta\varphi_{21}(t)\right)\cos\Delta\varphi_{21}(t)}$$

The total amplitude $A_{tot}(t) = A_1(t) + A_2(t)$ vs. time t is shown in the figure below, for time-independent/constant frequencies of $f_1 = 1000$ Hz and $f_2 = 980$ Hz, equal amplitudes of unit strength $A_{10} = A_{20} = 1.0$ and zero relative initial phase $\Delta\varphi_{21} = 0.0$



Clearly, the beats phenomenon can be seen in the above waveform of total amplitude $A_{tot}(t) = A_1(t) + A_2(t)$ vs. time t. When $A_{tot}(t) = 0$, we have complete destructive interference of the two individual amplitudes – *i.e*. the 2nd amplitude is 180° out of phase relative to the first. When $A_{tot}(t) = 2$, we have complete constructive interference of the two amplitudes – the two individual amplitudes are exactly in phase with each other. More on this, below…

From the above graph, it is also obvious that the beat period $\tau_{beat} = 1/f_{beat} = 0.050$ sec = 1/20th sec, corresponding to a beat frequency of $f_{beat} = 1/\tau_{beat} = 20$ Hz, which is simply the (absolute value of the) frequency difference $f_{beat} \equiv |f_1 - f_2|$ between $f_1 = 1000$ Hz and $f_2 = 980$ Hz. Thus, the beat period $\tau_{beat} = 1/f_{beat} = 1/|f_1 - f_2|$. When $f_1 = f_2$, the beat period becomes infinitely long, and no beats are heard.