

MATH 5 WORKSHEET : Decay & Q factor

Barrett
4/25/07

The wood stick from class has $f_0 = 2000$ Hz
and decay time of 0.02 s

a) Compute the Q factor of this oscillator :

Is Q more or less for a tuning fork?
(lump of jello?)

b) If the initial amplitude is 1 , what is the amplitude
 0.1 s later? (write formula if no calculator).

c) How long does the signal take to drop by 120 dB in
intensity? [Hint: first find the ratio of amplitudes needed]

MATH 15 WORKSHEET : Decay & Q factor
 SOLUTIONS

Barrett
4/25/07

The wood stick from class has $f_0 = 2000 \text{ Hz}$

and decay time of 0.02 s
 \uparrow
 τ

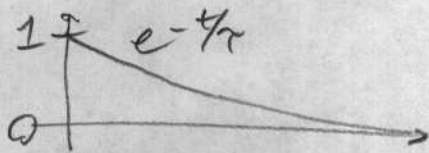
so period $T = \frac{1}{f_0}$
 $= \frac{1}{2000} \text{ s}$

a) Compute the Q factor of this oscillator:

$$Q = \pi \frac{\tau}{T} = \pi \frac{1/50}{1/2000} = 40\pi \approx 126$$

Is Q more or less for a tuning fork? more (10⁴ typ.)
 (lump of jello? less (1 typ.))

b) If the initial amplitude is 1, what is the amplitude 0.1 s later? (write formula if no calculator).



$$e^{-\frac{0.1}{0.02}} = e^{-5} = 0.0067$$

(less than 1% of original amplitude)

c) How long does the signal take to drop by 120 dB in intensity? [Hint: first find the ratio of amplitudes needed]

$$-120 \text{ dB} = 10 \log_{10} \frac{I_2}{I_1} \quad \text{so} \quad \frac{I_2}{I_1} = 10^{-12}$$

$$\frac{A_2}{A_1} = \sqrt{\frac{I_2}{I_1}} = \sqrt{10^{-12}} = 10^{-6}$$

take ln both sides, $\ln(e^x) = x$

$$\text{Finally } 10^{-6} = e^{-\frac{t}{0.02}} \quad \ln(10^{-6}) = \frac{-t}{0.02}$$

$$t = 0.02 (-\ln(10^{-6})) = 0.2765$$

pretty short decay!