1. 由 $L \geq \frac{f_s}{\Delta f} \geq \frac{10^4 Hz}{10 Hz} = 10^3$

故时长 $t = \frac{L}{f_s} = \frac{10^3}{10^4 Hz} = 0.1s$

由 Nyquist 采样定理，$f_{max} \leq \frac{1}{2} \cdot f_s = 5kHz$.

2. (1) $t = \frac{N}{f} = \frac{128}{40kHz} = 3.2 \times 10^{-3} s$.

(2). $w_0 = \frac{2\pi f}{f_s} = \frac{\pi}{4}$，考虑数字信号 $\sin(w_0 n)$，其冲激所在位置应为 $\frac{\pi}{4}$ 与 $\frac{7}{4}\pi$ 处. 那么有冲激的下标 k 显然为

$$K_1 = \frac{\pi}{4} \times \frac{1}{2\pi} \times 128 = 16, \quad K_2 = \frac{7\pi}{4} \times \frac{1}{2\pi} \times 128 = 112.$$

3. 由 $L \geq \frac{f_s}{\Delta f}$, $L = t \cdot f_s = 100$, 故 Δf 应 $\geq 100Hz$.

显然 $f_{2max} = 1.9kHz$, $f_{2min} = 1.1kHz$.