1. Consider the following algorithm for minimizing a function f:

$$x^{(k+1)} = x^{(k)} + \alpha_k d^{(k)},$$

where

$$\alpha_k = \arg\min_{\alpha} f\big(x^{(k)} + \alpha d^{(k)}\big).$$

Let $g^{(k)} = \nabla f\big(x^{(k)}\big)$ (as usual).
Suppose that f is quadratic with Hessian Q. We choose

$$d^{(k+1)} = \gamma_k g^{(k+1)} + d^{(k)},$$

and we wish the directions $d^{(k)}$ and $d^{(k+1)}$ to be Q-conjugate. Find a formula for γ_k in terms of $d^{(k)}$, $g^{(k+1)}$, and Q.