Suppose $A = M - N$ is a splitting and consider the stationary iteration $Mx_{k+1} = Nx_k + b$. Show that if $x_0 = 0$ then

$$x_k = \sum_{j=0}^{k} R^j M^{-1} b$$

where $R = M^{-1}N$. Note: we can compute the partial sum in closed form as

$$x_k = (I - R)^{-1}(I - R^{k+1})M^{-1}b$$

if $I - R$ is invertible – but you don’t need to prove this.