1. Derive the spectral resolution of the resolvent operator by expanding Q in $R_0 = -(H_0)^{-1}Q$.

2. Show that $E(\lambda) = \langle\Phi|\lambda V_\mathrm{c}|\Psi(\lambda)\rangle$.

3. Derive the following by induction

$$\frac{\partial^{m+1}}{\partial\lambda^{m+1}}\langle\Phi|\lambda V_\mathrm{c}|\Psi(\lambda)\rangle = (m+1)\langle\Phi|V_\mathrm{c}|\frac{\partial^m}{\partial\lambda^m}\Psi(\lambda)\rangle + \langle\Phi|\lambda V_\mathrm{c}|\frac{\partial^{m+1}}{\partial\lambda^{m+1}}\Psi(\lambda)\rangle \tag{1}$$

   and then use it to prove $E^{(m+1)} = \langle\Phi|V_\mathrm{c}|\Psi^{(m)}\rangle$.

4. Derive the recursive equation for $\Psi(\lambda)$.

$$\Psi(\lambda) = \Phi + R_0(\lambda V_\mathrm{c} - E(\lambda))\Psi(\lambda) \tag{2}$$

5. Derive all wavefunction and energy contributions up to second and third order, respectively.

6. Determine the first- and second-order components of the CI coefficients.

7. Show that ${}^{(2)}C_4 = \frac{1}{2}{}^{(1)}C_2^2$.