(Addendum on degenerate perturbation theory)

- Diagonalizing W may be easier if there is another hermitian operator $\mathcal{O}$ that commutes with both H_0 and H_1
  - So we can write 0^{th} order stationary states as $\mathcal{O}$ eigenstates
  - Also, $W_{mn} = 0$ unless $|\psi_m^0\rangle$ and $|\psi_n^0\rangle$ have same $\mathcal{O}$ eigenvalue

  <u>Proof</u> $W_{mn} = \langle \psi_m^0 | H_1 | \psi_n^0 \rangle = 1/\lambda_n \langle \psi_m^0 | H_1 \mathcal{O} | \psi_n^0 \rangle$

  where λ_n = eigenvalue of $|\psi_n^0\rangle$

  But then $\mathcal{O}$ commutes

  $$W_{mn} = 1/\lambda_n \langle \psi_m^0 | \mathcal{O} H_1 | \psi_n^0 \rangle = 1/\lambda_n \langle \psi_n^0 | H_1 \mathcal{O} | \psi_m^0 \rangle^*$$

  $$= (\lambda_m/\lambda_n) \langle \psi_m^0 | H_1 | \psi_n^0 \rangle = (\lambda_m/\lambda_n) W_{mn}$$

  This is zero unless $\lambda_m = \lambda_n$

  - So look for some conserved hermitian operator.

  On HW, this is L_z