

ii) Explain why the Max excitation level of the wavefunction increases by t^2 with each order in perturbation theory.

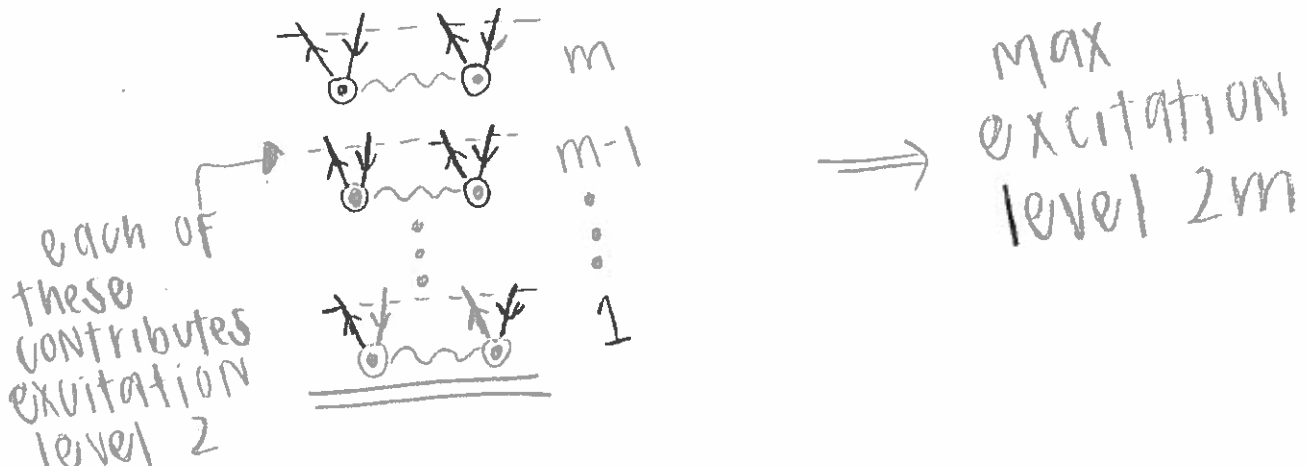
$$\psi = \psi^{(0)} + \psi^{(1)} + \psi^{(2)} + \dots$$

$$= \psi_0 \Phi + [R_0 V_0 \Phi + \text{bracketings}] + [(R_0 V_0)^2 \Phi + \text{bracketings}] + \dots$$

$$\psi^{(m)} = \underbrace{(P_0 V_0)^m \Phi}_{\text{BRACKETINGS}}$$

where this term is always going to contain the highest excitation level.

Now if we want to find the term of $(\rho_0 V_0)^m \bar{\Phi}$ that has the highest excitation level, it will be the one with all creation operators:



So if we're considering going from $m \rightarrow m+1$,
the excitation levels will go from

$$2m \rightarrow 2(m+1) = 2m + 2$$

increases
by 2