

# QSIT 2010 - Questions 6

10. November 2010

1. **Two-level approximation for a Cooper-pair box**

The Hamiltonian for a Cooper-pair box is given by

$$H_{CPB} = \sum_n \left[ E_C (\hat{n} - n_g)^2 |n\rangle\langle n| - \frac{E_J}{2} (|n\rangle\langle n+1| + |n+1\rangle\langle n|) \right].$$

Write down the Hamiltonian for the two-dimensional qubit subspace in terms of the Pauli matrices  $\sigma_x$  and  $\sigma_z$  by restricting the quantum states to  $n = 0, 1$ . What is the transition frequency between ground and excited state?