

Chem. 540

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### PROBLEM FORMALISM 5

The operator  $f(\hat{A})$ , where  $\hat{A}$  is an operator and  $f$  is any function, is defined by the Taylor series expansion of the function. For example,

$$e^{\hat{A}} \equiv \sum_{k=0}^{\infty} \frac{1}{k!} \hat{A}^k.$$

Show (in general) that if  $|a\rangle$  is an eigenstate of  $\hat{A}$  with eigenvalue  $\lambda$ , then  $|a\rangle$  is also an eigenstate of the operator  $f(\hat{A})$ . Find the latter's eigenvalue.