

## QUANTUM MECHANICS 2 - WORKSHOP 9

Q1: An operator representing an observable  $A$  has two normalised eigenstates,  $\psi_1$  and  $\psi_2$ , with eigenvalues  $a_1$  and  $a_2$ . A second operator representing an observable  $B$  also has two normalised eigenstates,  $\phi_1$  and  $\phi_2$ , with eigenvalues  $b_1$  and  $b_2$ . The eigenstates are related by

$$\psi_1 = \frac{3\phi_1 + 4\phi_2}{5}, \quad \psi_2 = \frac{4\phi_1 - 3\phi_2}{5}.$$

- (a) Observable  $A$  is measured, and the eigenvalue  $a_1$  is the obtained measurement value. What is the state of the system immediately after the measurement?
- (b) if  $B$  is subsequently measured, what are the possible measurement values that can be obtained, and what are their probabilities?
- (c) Immediately after the measurement of  $B$ ,  $A$  is measured again. What is the probability of obtaining  $a_1$  as a measurement value?
- (d) Suppose the measurement of  $B$  had not taken place and  $A$  is immediately measured again. What then is the probability of obtaining  $a_1$  as a measurement value?
- (e) What if the measurement of  $B$  had taken place but you did not know this fact? What is the probability of getting  $a_1$  if  $A$  is immediately measured again?

Q2: Which of the following operators are necessarily Hermitian given that  $A$  and  $B$  are Hermitian operators and  $c$  is a real constant

- i)  $A + B$
- ii)  $cA$
- iii)  $AB$
- iv)  $AB + BA$  ?