Exercise 6.5.

1. When any of Alice’s or Bob’s spin operators acts on a product state, the result is a product state
2. Show that in a product state, the expectation of any component of  is the same as it would be in the individual spin states.

Solution.

1. Let  be a product state and let . Then  is another of Alice’s states. Thus



is a product state, and similarly for Bob.

1. In part 1, if  is normalized (i.e., a unit vector) then so is  since  (whether ). If, in addition,  is normalized, then so is :

First we have to define what we mean for  to be a unit vector. We would want it to satisfy . Since *A* and *B* cannot be co-mingled, we must define . Since  are normalized, . Hence  if we define  for any .

Since both  and  are normalized, then equation (4.14) in the book is valid:



where the first  is in the product state and the final  is in Alice’s spin state.

Of course, the proof for  is similar.