

Problem A

For each of the following 2-particle spin states, determine whether the state is entangled or not. For those states which are not entangled, calculate the factored individual spin states. For which are entangled, show explicitly that they cannot be factored.

(a) $\uparrow\uparrow$

(b) $\frac{1}{2}\uparrow\uparrow - \frac{1}{2}\uparrow\downarrow + \frac{1}{2}\downarrow\uparrow - \frac{1}{2}\downarrow\downarrow$

(c) $\frac{1}{\sqrt{2}}\uparrow\downarrow - \frac{1}{\sqrt{2}}\downarrow\uparrow$ (the $s = 0$ singlet)

(d) $\frac{i}{2}\uparrow\uparrow + \frac{1}{2}\uparrow\downarrow - \frac{1}{2}\downarrow\uparrow + \frac{i}{2}\downarrow\downarrow$