

Name: \_\_\_\_\_

## Quiz #3

Toggerson Physics 564

### Instructions

Answer each question in a few words or a few lines of algebra.

If you are doing a lot of work, you are going down the wrong path.

No resources.

No need to explain anything today! You can just write answers.

**A coefficient you may find useful:**  $\hbar\sqrt{s(s+1) - m(m \pm 1)}$

### Question 1 [5pts]

For a spin- $\frac{1}{2}$  system, what is  $S_+|\uparrow\rangle$ ?

**I cannot raise the “top of the ladder” so this is zero.**

### Question 2 [5pts]

For a spin- $\frac{1}{2}$  system, what is  $S_+|\downarrow\rangle$ ?

$$\begin{aligned} S_+|\downarrow\rangle &= \hbar\sqrt{s(s+1) - m(m+1)}|\uparrow\rangle \\ S_+|\downarrow\rangle &= \hbar\sqrt{\frac{1}{2}\left(\frac{1}{2}+1\right) - \left(-\frac{1}{2}\right)\left(-\frac{1}{2}+1\right)}|\uparrow\rangle \\ S_+|\downarrow\rangle &= \hbar\sqrt{\frac{3}{4} + \frac{1}{4}}|\uparrow\rangle = \hbar|\uparrow\rangle \end{aligned}$$

### Question 3 [5pts]

For a spin-1 system, what is  $S_+|s_z = +\hbar\rangle$ ?

**I cannot raise the “top of the ladder” so this is zero.**

### Question 4 [5pts]

For a spin-1 system, what is  $S_+|s_z = 0\rangle$ ?

$$\begin{aligned} S_+|0\rangle &= \hbar\sqrt{s(s+1) - m(m+1)}|1\rangle \\ S_+|0\rangle &= \hbar\sqrt{1(1+1) - (0)(0+1)}|1\rangle \\ S_+|0\rangle &= \hbar\sqrt{2+0}|\uparrow\rangle = \hbar\sqrt{2}|\uparrow\rangle \end{aligned}$$