problem exemple

$$S_- |s\ m\rangle = S_-|1\ 0\rangle$$

$s = 1$ [spin value]
$m = 0$ [quantum value]

$$S_- = \hbar\sqrt{s(s+1)-m(m-1)}\ |s\ m-1\rangle$$

$$S_-|s\ m\rangle = \hbar\sqrt{1(1+1)-0(0-1)}\ |1\ -1\rangle$$

$$= \hbar\sqrt{(2)-0}\ |1\ -1\rangle$$

$$= \hbar\sqrt{2}$$ ↓↓

1) See the question : $S_-|1\ 0\rangle$
2) derive the question in core equation : $S_-|s\ m\rangle$
3) Know the equation of S_- : $\hbar\sqrt{s(s+1)-m(m-1)}\ |s\ m\rangle$
4) Do the derivative

0 [no values higher then max value]

$\uparrow$

$S_- \rightarrow |1\ \ 1\rangle = \uparrow\uparrow \longleftarrow S_+$

$S_- \rightarrow\downarrow |1\ \ 0\rangle = \frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow) \longleftarrow\uparrow S_+$

$S_- \rightarrow\downarrow |1\ {-1}\rangle = \downarrow\downarrow \longleftarrow\uparrow S_+$

$\downarrow$

0 [no values lower then minimum value]

[singlet configuration]

$S_\pm |0\ \ 0\rangle = \frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)$

if i add S_+, it will go up but there is no value higher then max value [in this case max is 0] so automatically its 0

→ same for min value

$S_+ \textcircled{n_+}\ 0$

$S_- \textcircled{n_-}\ 0$

$$S_\pm |0\ \ 0\rangle = 0 \Rightarrow S_-\left(\frac{1}{\sqrt{2}}(\overset{n_1}{\uparrow}\overset{n_2}{\downarrow} - \overset{n_1}{\downarrow}\overset{n_2}{\uparrow})\right)$$

$$\left(S_-^{(1)} + S_-^{(2)}\right)\left(\frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)\right)$$

$$= \frac{1}{\sqrt{2}}\left(S_-^{(1)}\uparrow\right)\downarrow + \frac{1}{\sqrt{2}}\uparrow\left(S_-^{(2)}\downarrow\right)$$

$\lambda_1 \Rightarrow \overset{\uparrow\uparrow}{\uparrow\downarrow}$ $\lambda_2 \rightarrow \overset{\uparrow\uparrow}{\uparrow\downarrow}$

4 different states

$$= \frac{1}{\sqrt{2}}\left(S_-^{(1)}\uparrow\right)\downarrow + \frac{1}{\sqrt{2}}\uparrow\left(S_-^{(2)}\downarrow\right) - \frac{1}{\sqrt{2}}\left(S_-^{(1)}\downarrow\right)\uparrow$$

$$- \frac{1}{\sqrt{2}}\downarrow\left(S_-^{(2)}\uparrow\right)$$

—x—x—x—x—x—x—x—x—x—x

<0] [0]

cleaner version

$S_\pm|0\ 0\rangle$ = no values higher / lower then max / min value

in terms of S_+ S_-

$= 0$

1) We know=

$\underbrace{S_{\pm}}_{-}|0\ 0\rangle \rightarrow = \frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)$

only this ay

$= \boxed{S_-}\left[\frac{1}{\sqrt{2}}\underbrace{(\uparrow\downarrow - \downarrow\uparrow)}\right]$

two possible λ_1 and λ_2 notations

$\lambda_1 = \uparrow\uparrow$
$= \uparrow\downarrow$

$\lambda_2 = \uparrow\uparrow$
$= \uparrow\downarrow$

$\therefore S_-$ alone

$S_-^{(1)}$ $S_-^{(2)}$

$S_-\left[\frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)\right]$

$= \left(S_-^{(1)} + S_-^{(2)}\right)$

$\left[\frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)\right]$

$= S_-^{(1)}\ \uparrow\downarrow$
$\quad\ \uparrow\downarrow$
$S_-^{(2)}\ \downarrow\uparrow$
$\quad\ \downarrow\uparrow$

= multiplication rule

$S_-^{(1)}\left[\frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)\right]$ *

$+ S_-^{(2)}\left[\frac{1}{\sqrt{2}}(\uparrow\downarrow - \downarrow\uparrow)\right]$

ignore the duplicate states

$$\Rightarrow \frac{1}{\sqrt{2}}\left(\left(S_-^{(1)}\uparrow\right)\downarrow + \frac{1}{\sqrt{2}}\uparrow\left(S_-^{(2)}\downarrow\right)\right.$$

$$\left. - \frac{1}{\sqrt{2}}\left(S_-^{(2)}\downarrow\right)\uparrow - \frac{1}{\sqrt{2}}\downarrow\left(S_-^{(2)}\uparrow\right)\right)$$

~~$\Rightarrow \frac{1}{\sqrt{2}}\left(\hbar\downarrow\downarrow\right.$~~

$=0$

$S_-\uparrow_-$

$$\Rightarrow \frac{1}{\sqrt{2}}\left(\underbrace{S_-^{(1)}\uparrow}\right)\downarrow + \frac{1}{\sqrt{2}}\uparrow\left(\underbrace{S_-^{(2)}\downarrow}\right) - \frac{1}{\sqrt{2}}\left(S_-^{(2)}\downarrow\right)\uparrow - \frac{1}{\sqrt{2}}\downarrow\left(S_-^{(2)}\uparrow\right)$$

$$= \frac{1}{\sqrt{2}}\left(\hbar\downarrow\right)\downarrow + \frac{1}{\sqrt{2}}(0) - \frac{1}{\sqrt{2}}(0) - \frac{1}{\sqrt{2}}\downarrow\left(\hbar\downarrow\right)$$

$$= \frac{1}{\sqrt{2}}\hbar\downarrow\downarrow - \frac{1}{\sqrt{2}}\hbar\downarrow\downarrow$$

$$\boxed{I=0}$$