915.

Problem 56.21 (RHK)

We have to explain using quark model why there are no known mesons with $Q = +1$ and $S = -1$ or with $Q = -1$ and $S = +1$.

Solution:

Properties of the fundamental quarks are as given in the following table:

Quark	*Symbol*	*Charge (e)*	*Spin*	*Baryon Number*	*Strangeness*
Up	u	$+\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	0
Down	d	$-\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	0
Strange	s	$-\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	-1

The charge, baryon number, and strangeness of $\bar{u}$, $\bar{d}$, and $\bar{s}$ are opposite of u, d, and s, respectively.

Mesons have baryon number 0, therefore they comprise of one quark and one anti-quark. A meson with charge $Q = +1$ can either be the combination $u\bar{d}$, or $u\bar{s}$. The strangeness of $u\bar{d}$ is 0 and that of $u\bar{s}$ is $+1$. Therefore, there is no known meson with $Q = +1$ and $S = -1$.

Meson with $Q = -1$ has to be the quark combination $\bar{u}d$ or $\bar{u}s$. The strangeness of $\bar{u}d$ is zero and that of $\bar{u}s$ is -1. Therefore, there is no known meson with $Q = -1$ and $S = +1$.