Introduction to strangeness

Unlike baryon number and charge, which are conserved in all interactions, strangeness, S, is only conserved in strong interactions.

Here is a list of the B, Q and S values of some of the more common particles:

Particle	**B**	**Q**	**S**
p	+1	+1	0
n	+1	0	0
π^+	0	+1	0
π^-	0	-1	0
π^0	0	0	0
K^+	0	+1	+1
K^-	0	-1	-1
Λ^0	+1	0	-1
Σ^0	+1	0	-1
Σ^+	+1	+1	-1
Σ^-	+1	-1	-1
Ξ^0	+1	0	-2
Ξ^-	+1	-1	-2
Ω^-	+1	-1	-3
K^0	0	0	±1 (tricky!)

The K^0 puzzled physicists particularly in the early years of particle physics. We will discuss it no more here, but ask you to accept it.

Now let us return to the collision we have been studying,

$$K^- \, p \to p \, K^0 \, h^-$$

where h^- is an unknown hadron. The most likely candidates are π^-, K^- or $\overline{p}$.

In order to narrow our possibilities down, we look at B, Q and S conservation using the table above:

	K^-	p	$\to$	p	K^0	h^-	Comment
Q	-1	+1		+1	0	-1	Conserved
B	0	+1		+1	0	?	? must be 0, so $\overline{p}$ impossible
S	-1	0		0	±1	?	? cannot be -1, so K^- impossible

From this we can conclude that the unknown hadron is a π^-.

Conservation laws are useful in that they enable one to say, with little effort, whether a reaction is possible or not. Below is an exercise in the use of these conservation laws.

Question: Which of these collisions are possible? Give reasons.

(1) $\pi^+ p \to \pi^+ p \, \pi^+ \pi^-$
(2) $\pi^+ p \to \pi^+ p \, \pi^+ K^-$
(3) $K^- p \to K^- p \, K^+ K^-$
(4) $K^- p \to K^+ p \, K^+ K^-$

Answer:

(1) Obeys Q, B and S conservation; possible.
(2) Obeys Q and B conservation only, but violates S conservation; impossible.
(3) Obeys Q, B and S conservation; possible.
(4) Obeys B conservation, but violates Q and S conservation; impossible.

Don't forget: The collision reactions are only possible, if there is enough energy available to make the new particles.