**916.**

**Problem 56.22 (RHK)**

*We have to analyze the following decays or reactions in terms of the quark contents of the particles*:
(a) $\Sigma^- \to n + \pi^-$; (b) $K^0 \to \pi^+ + \pi^-$; (c) $\pi^+ + p \to \Sigma^+ + K^+$; (d) $\gamma + n \to \pi^- + p$.

**Solution:**

We write the quark contents of the particles involved in the decays and reactions that we are analyzing.

$$p = uud \quad n = udd \quad \Sigma^+ = uus \quad \Sigma^- = dds$$
$$\pi^+ = u\bar{d} \quad \pi^- = d\bar{u} \quad K^+ = u\bar{s} \quad K^0 = d\bar{s}$$

(a)

We write the quark contents of the particles in the decay $\Sigma^- \to n + \pi^-$. We get

$$dds \to udd + d\bar{u} .$$

Cancelling the two dd from the left and the right sides of the decay relation, we get

$$s \to d + u + \bar{u}.$$

That is in the weak interaction process an s quark is transformed into a d quark and a $u\bar{u}$ pair is created from the decay energy.

(b)

We write the quark contents of the decay process

$K^0 \to \pi^+ + \pi^-$. We get

$d\bar{s} \to u\bar{d} + d\bar{u}$ .

Cancelling d from the left and the right sides of the decay process relation, we get

$\bar{s} \to \bar{d} + u + \bar{u}$.

That is in the weak interaction process an $\bar{s}$ quark is transformed into a $\bar{d}$ quark and a $u\bar{u}$ pair is created from the decay energy.

(c)

We write the quark contents of the particles in the reaction $\pi^+ + p \to \Sigma^+ + K^+$. We get

$u\bar{d} + uud \to uus + u\bar{s}$ .

By cancelling out uuu from the left and the right hand sides of the reaction, we note that $d\bar{d}$ pair goes into $s\bar{s}$ pair. The reaction process takes place due to strong force.

(d)

We write the quark contents of the particles in the reaction $\gamma + \mathrm{n} \rightarrow \pi^{-} + \mathrm{p}$. We get

$\mathrm{udd} \rightarrow \mathrm{d\bar{u}} + \mathrm{uud}$.

In this reaction process which is due to force of electromagnetic interaction udd goes into udd plus $\mathrm{u\bar{u}}$ pair.