

ANALYSIS OF ELEMENTARY PARTICLE REACTIONS

In order to analyze elementary particle reactions at a beginning level you must consider conservation of charge, baryon number, electron number, muon number, and tauon number. Energy is also conserved, but may appear in a variety of forms, some of which forms are difficult to quantify. Therefore you will need to examine kinetic energy before the reaction. If there is only minimal initial kinetic energy (as in decays), then the rest energy (mass) total for the products should be less than the rest energy of the reactant. In a strong interaction strangeness also will be conserved.

Example:

Complete the reaction:

Property	$\Lambda^0 \longrightarrow$	P^+	$+$	e^-	$+$	$?$
Charge	0	+1		-1		<i>0</i>
Mass (MeV)	1116	938		.5		<i><177</i>
Baryon Number	1	1		0		<i>0</i>
Electron Number	0	0		+1		<i>-1</i>
Muon Number	0	0		0		<i>0</i>
Tauon Number	0	0		0		<i>0</i>

In order to conserve the various properties, the unknown particle will need the properties indicated in ***bold italics***. Therefore it must be the electron's antineutrino ($\bar{\nu}_e$).

ELEMENTARY PARTICLES REACTIONS - I

Use the conservation laws to supply the missing particles(s) in each of the following reactions.

A) WEAK NON-LEPTONIC DECAYS OF HADRONS

1. K^+ \rightarrow π^+ +
2. Λ^0 \rightarrow N^0 +
3. K^0 \rightarrow π^+ +
4. Λ^0 \rightarrow P^+ +
5. Σ^+ \rightarrow P^+ +
6. K^+ \rightarrow π^+ + π^+ +
7. Ξ^0 \rightarrow Λ^0 +
8. K^0 \rightarrow π^0 +
9. Σ^+ \rightarrow N^0 +
10. Ω^- \rightarrow Ξ^0 +
11. Ξ^- \rightarrow Λ^0 +
12. Σ^- \rightarrow N^0 +

B) WEAK, LEPTONIC DECAYS OF HADRONS AND LEPTONS

13. π^+ \rightarrow μ^+ +
14. π^0 \rightarrow γ + e^+ +
15. π^- \rightarrow π^0 + e^- +
16. K^+ \rightarrow ν_μ +

17.	K^0	π^+	+	ν_e	+
18.	N^0	p^+	+	e^-	+
19.	μ^-	e^-	+		+
20.	Λ^0	p^+	+	e^-	+
21.	τ^+	μ^+	+		+
22.	D^0	K^0	+	π^+	+

C) STRONG, HADRONIC REACTIONS (Assume sufficient incident energy.)

23.	N^0	+	p^+	p^+	+	p^+	+
24.	p^+	+	p^+	p^+	+	π^+	+
25.	p^+	+	π^+	Σ^+	+		
26.	π^0	+	p^+	p^+	+	π^+	+
27.	K^-	+	p^+	Σ^+	+		
28.	K^-	+	p^+	Σ^-	+		
29.	K^-	+	p^+	Λ^0	+		
30.	π^-	+	p^+	N^0	+	π^-	+

ELEMENTARY PARTICLE REACTIONS-II

Indicate the validity of each of the following decay processes. For any reactions which are not valid, state a reason.

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|-----|-------------|-------------|---|-----------|---|-----------|--|
| 1. | K^- | μ^- | + | ν_μ | | | |
| 2. | π^+ | μ^+ | + | ν_μ | | | |
| 3. | Λ^0 | p^+ | + | π^- | | | |
| 4. | π^- | μ^+ | + | ν_e | | | |
| 5. | π^- | μ^- | + | ν_μ | | | |
| 6. | N^0 | p^+ | + | π^- | | | |
| 7. | Σ^+ | N^0 | + | π^0 | | | |
| 8. | N^0 | p^+ | + | e^- | + | ν_e | |
| 9. | μ^+ | e^- | + | ν_e | + | ν_μ | |
| 10. | K^+ | μ^+ | + | π^0 | + | ν_e | |
| 11. | π^0 | e^+ | + | e^- | + | ν_e | |
| 12. | μ^- | e^- | + | ν_e | + | ν_μ | |
| 13. | Ξ^0 | Λ^0 | + | π^0 | | | |
| 14. | K^0 | π^0 | + | π^0 | + | π^+ | |
| 15. | Λ^0 | N^0 | + | π^0 | + | ν_e | |