

Sum of reactions for charging (not including Pyrophosphatase)
( rxn 1 ) tRNA $+\mathrm{AA} \rightarrow \mathrm{AA} \sim$ RRNA (+ water )
(xn 2) ATP (+ water) $\rightarrow \mathrm{AMP}+\mathrm{PP}_{i}$
How reactions $1 \& 2$ are coupled:
(a) $\mathrm{ATP}+\mathrm{AA} \rightarrow \mathrm{AMP} \sim \mathrm{AA}+\mathrm{PP}_{\mathrm{i}}$
(b) AA $\sim A M P+t R N A \rightarrow A A \sim t R N A+A M P$

Sum $(\mathrm{a})+(\mathrm{b})=\mathrm{ATP}+\mathrm{AA}+\mathrm{tRNA} \rightarrow \mathrm{AMP}+\mathbf{P P} \mathrm{i}_{\mathrm{i}}+\mathrm{AA} \sim \mathbf{t R N A}=\operatorname{sum}(1)+(2)$

Sum of reactions for charging -- including Pyrophosphatase

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\mathbf{A T P}+\mathbf{A A}+\mathrm{tRNA} \rightarrow \mathbf{A M P}+2 \mathrm{P}_{\mathrm{i}}+\mathrm{AA} \sim \mathbf{t R N A}
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