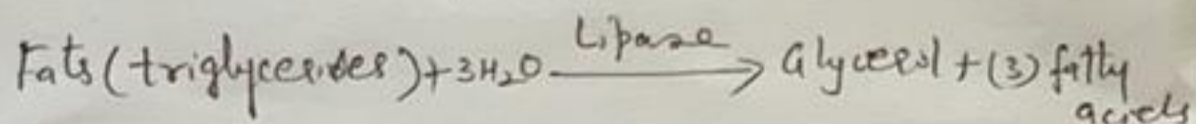


## Lipid Metabolism

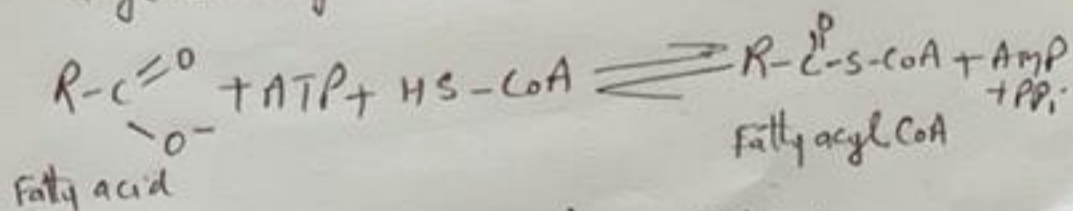
 $\beta$ -oxidation of fatty acids

- Fatty acids undergo oxidation in mitochondria
- According to F. Knoop, fatty acids are degraded by oxidation at the  $\beta$ -carbon, followed by successive release of 2-C fragments in the form of acetyl CoA.

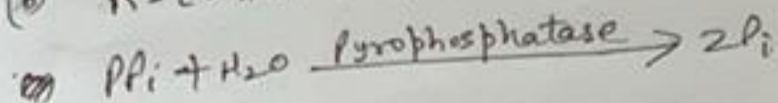
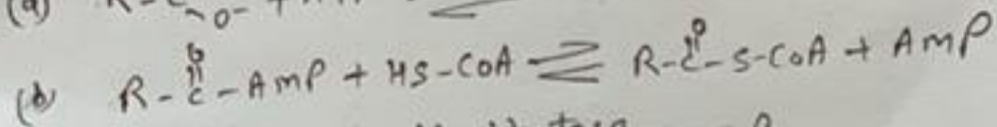
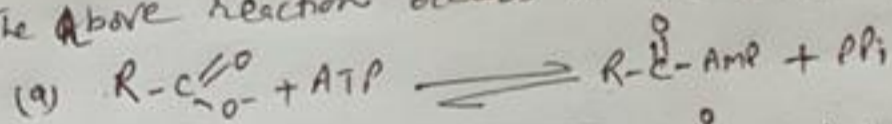
- Activation of fatty acids.

(i) Fatty acids must undergo activation before they enter into the mitochondrial matrix.

(ii) Activation reaction occurs on the outer mitochondrial membrane, catalyzed by acyl CoA synthase.



The above reaction occurs in two steps:



- (2)
- Activated fatty acids i.e. fatty acyl CoAs are degraded by a recurring sequence of four ~~steps~~ reactions;

(i) Oxidation (by FAD)

(ii) Hydration

(iii) Oxidation (by  $\text{NAD}^+$ )

(iv) Thiolysis (by CoA)

(A linear pathway for breakdown of fatty acids -  $\beta$  oxidation - is attached).

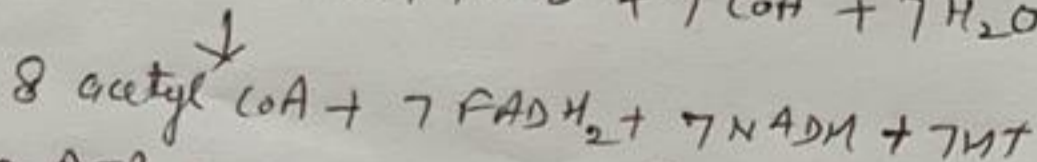
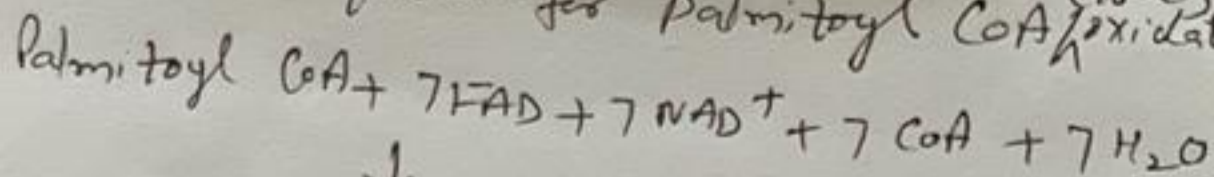
- In the end, the fatty acyl chain is shortened by two carbon atoms and FADH, NADH and acetyl CoA are generated.
- The fatty acid residue can be subjected again and again to the same degradative pathway to obtain chunks of 2-C fragments as acetyl CoA.
- The acetyl CoA can be degraded in the Krebs cycle or can be used for the synthesis.

Overall ATP yield from oxidation of fatty acetyl CoA ~~by the Krebs cycle~~ in one round;

I round {  
3 ATP from 1 NADPH  
2 ATP from 1 FADH  
12 ATP from oxidation of acetyl CoA by Krebs cycle

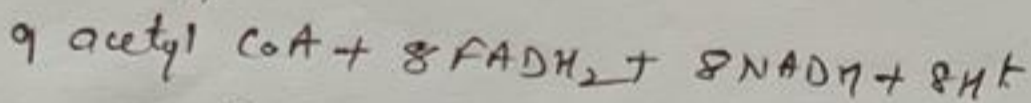
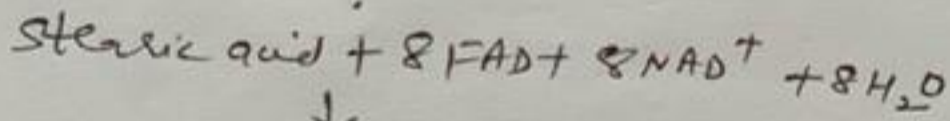


- (3)
- The overall equation for Palmitoyl CoA<sup>(C16-C)</sup> oxidation



Note: 2 ATP are consumed for activation of Palmitate.

- The overall equation for stearic acid (C-18) oxidation:



Note: 2 ATP are consumed for activation of stearic acid and are hydrolysed to yield 2AMP and 2P<sub>i</sub>.

### Numericals

- How many ATP molecules are produced from complete oxidation of one molecule of stearic acid?
- How many ATP molecules are produced from complete oxidation of one molecule of palmitic acid?

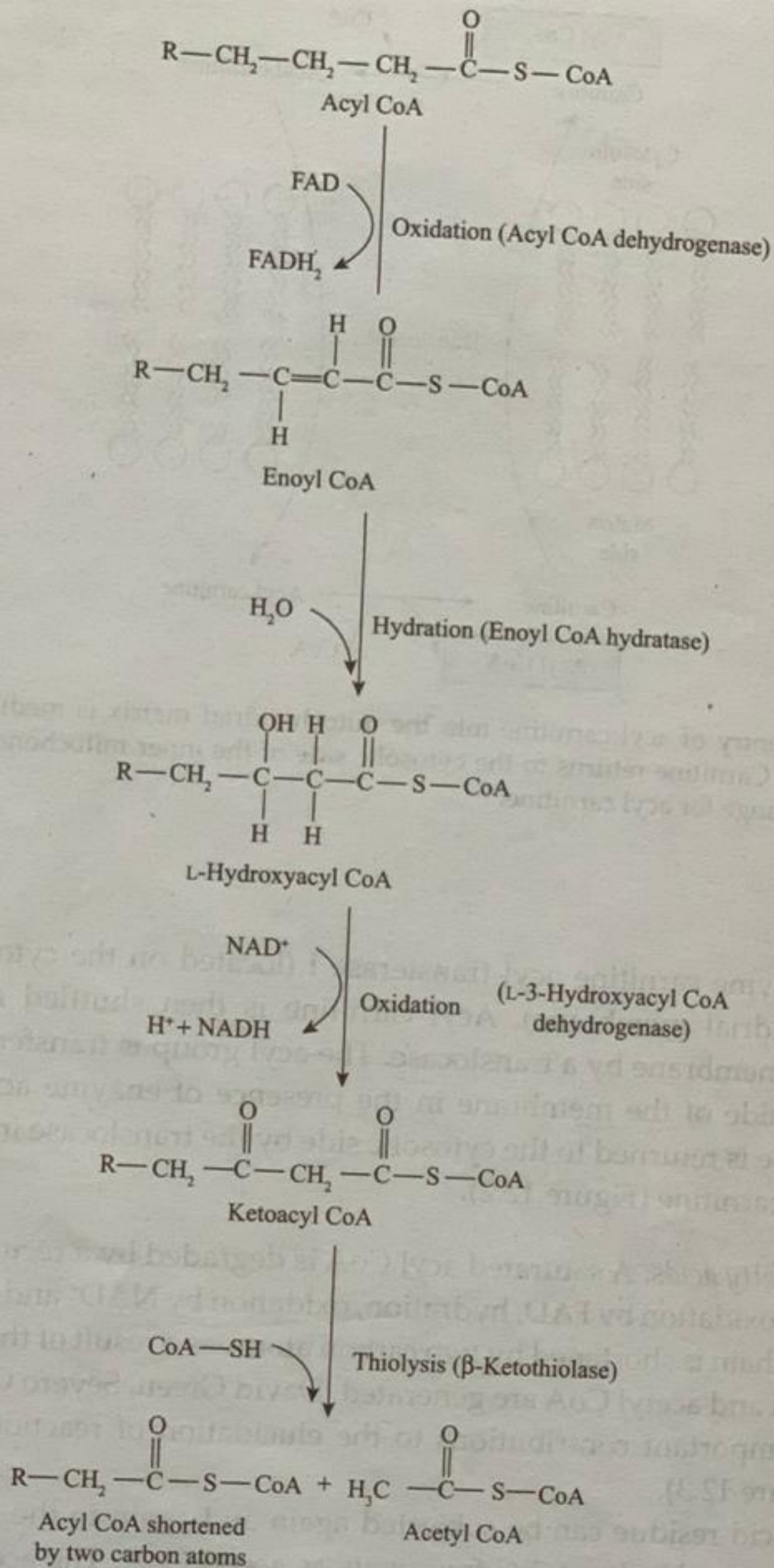
(4)

3. How many ATP molecules are produced from one acetyl CoA in the Krebs cycle?

### Points to remember

1. Fatty acid oxidation occurs in mitochondrial matrix.
2. Intermediates in fatty acid oxidation are bonded to CoA.
3. Enzymes of fatty acid oxidation are not associated in multi enzyme complex.
4. Reductant/<sup>generated</sup> in fatty acid oxidation is ~~NADH~~ and FADH
5. David Green, Severo Ochoa and Feodor Lynen played important role in the elucidation of reactions of  $\beta$ -oxidation pathway.





**Figure 12.3** Reaction sequence in the breakdown ( $\beta$ -oxidation) of fatty acids involving oxidation, hydration, oxidation and thiolysis.