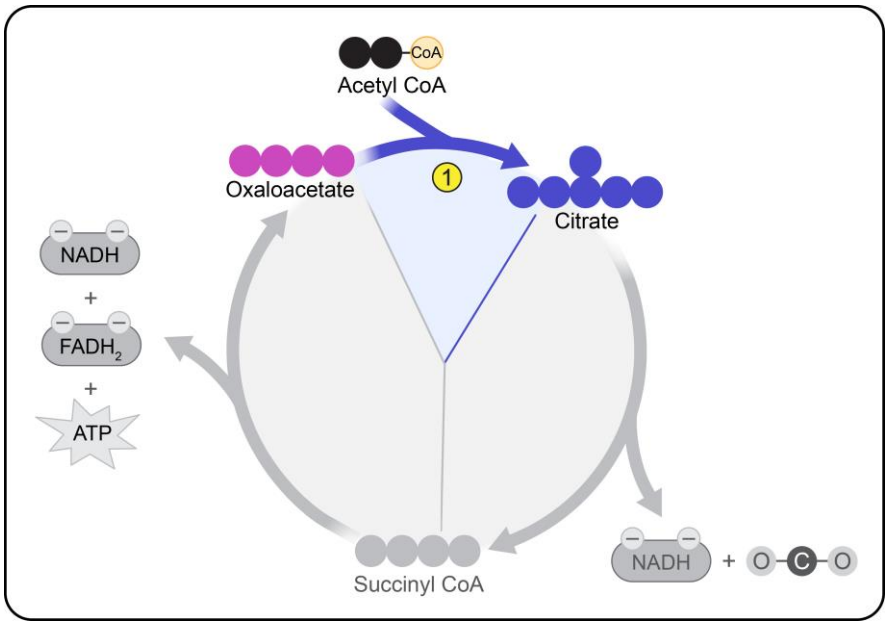
CONCEPT: THE CITRIC ACID CYCLE

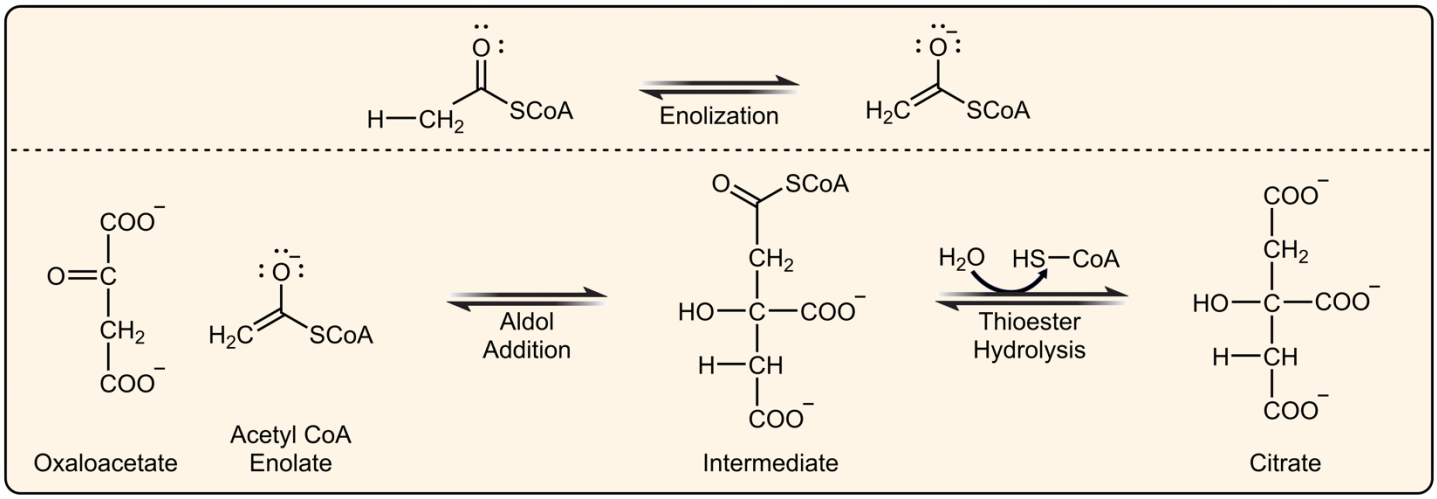
- The citric acid cycle is a sequence of ___ biochemical reactions.

Phase A – Citrate Formation

- Phase A consists of the _____ reaction of the pathway.



1 Citrate Formation: acetyl group from acetyl CoA combines with ___ of oxaloacetate to give second metabolite, citrate.



EXAMPLE: How many carbon atoms are added to oxaloacetate to produce citrate?

a) One

b) Two

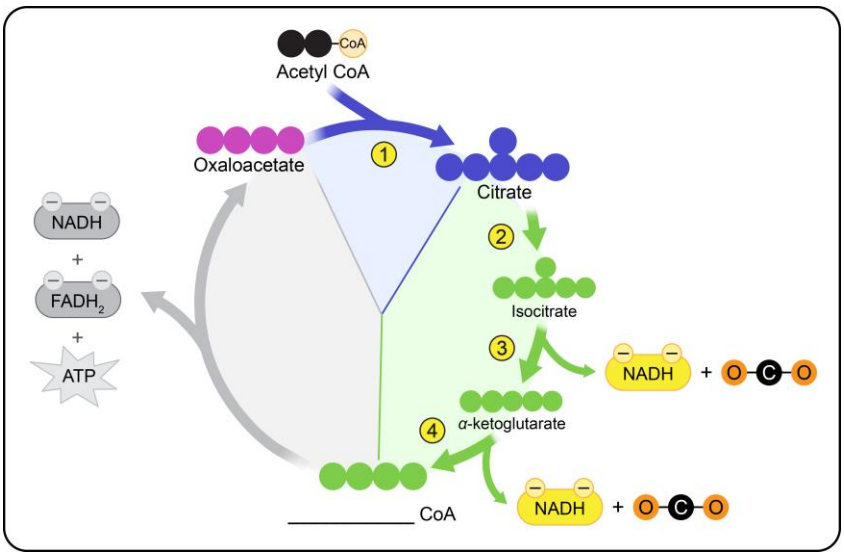
c) Three

d) Four

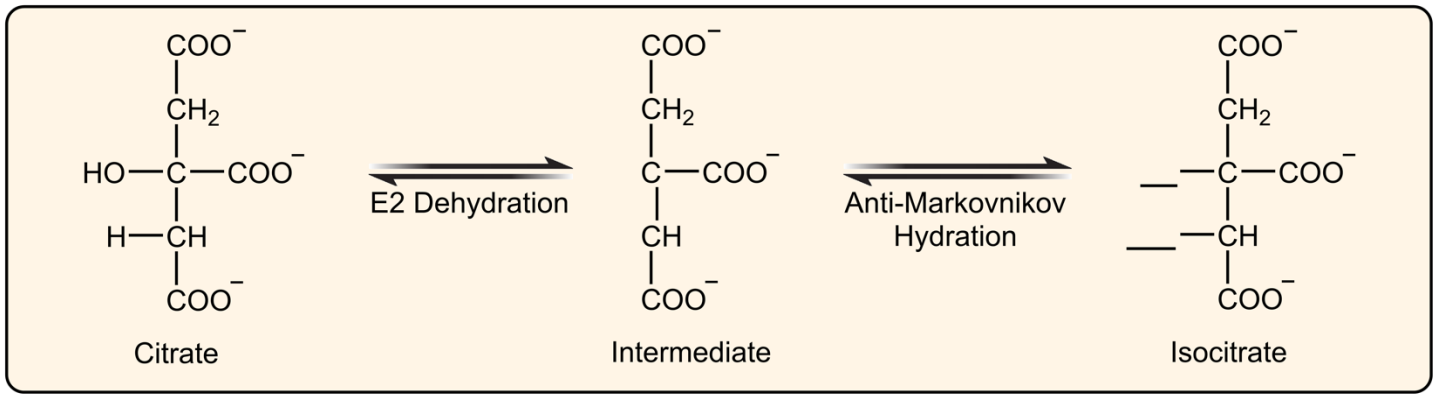
CONCEPT: THE CITRIC ACID CYCLE

Phase B – Succinyl CoA Formation

- Phase B consists of the pathway's reactions ___, ___, and ___.
  - □ Produces ___ moles each of NADH and CO_2.

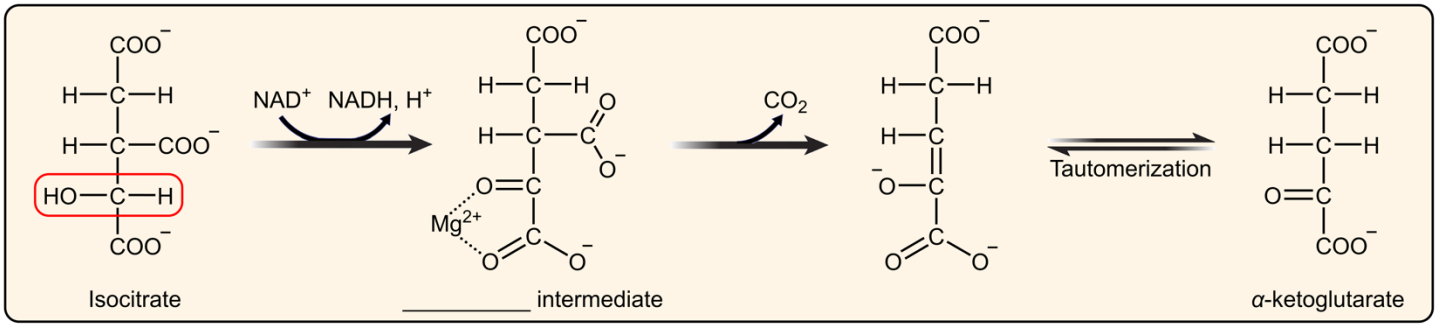


2 Isomerization: the 3° –OH in citrate isomerizes to a 2° –OH for _____ in the following step.



3 Alcohol Oxidation & Decarboxylation (1st): _____ _____ with NAD^+.

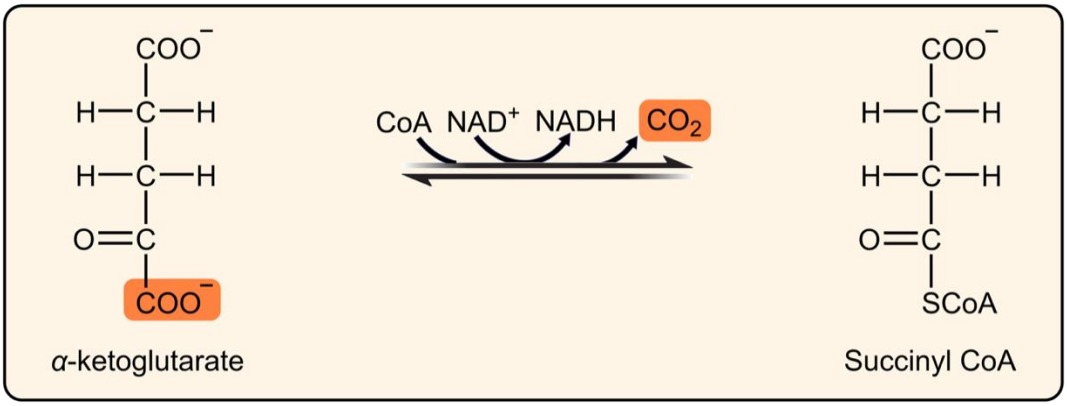
- □ 1 NAD^+ is reduced to 1 _____.
- □ 1 C atom is lost as _____.



CONCEPT: THE CITRIC ACID CYCLE

4 Oxidation & Decarboxylation (2nd): _____ Oxidation + Decarboxylation.

□ 1 NAD^+ is reduced to 1 _____. □ 1 C atom is lost as _____.



EXAMPLE: For each of the following reactions described below, identify a corresponding step of the citric acid cycle.

a) ____ Oxidation of α-ketoglutarate produces succinyl CoA.

b) ____ Oxaloacetate is converted to citrate.

c) ____ An oxidation reaction is catalyzed by isocitrate dehydrogenase.

d) ____ Aconitase catalyzes the isomerization of citrate to isocitrate.

PRACTICE: Which step oxidizes α-ketoglutarate of the Citric Acid Cycle?

a) 3

b) 1

c) 4

d) 5

PRACTICE: Which two steps of the citric acid cycle produce CO_2?

a) 1 and 3

b) 3 and 4

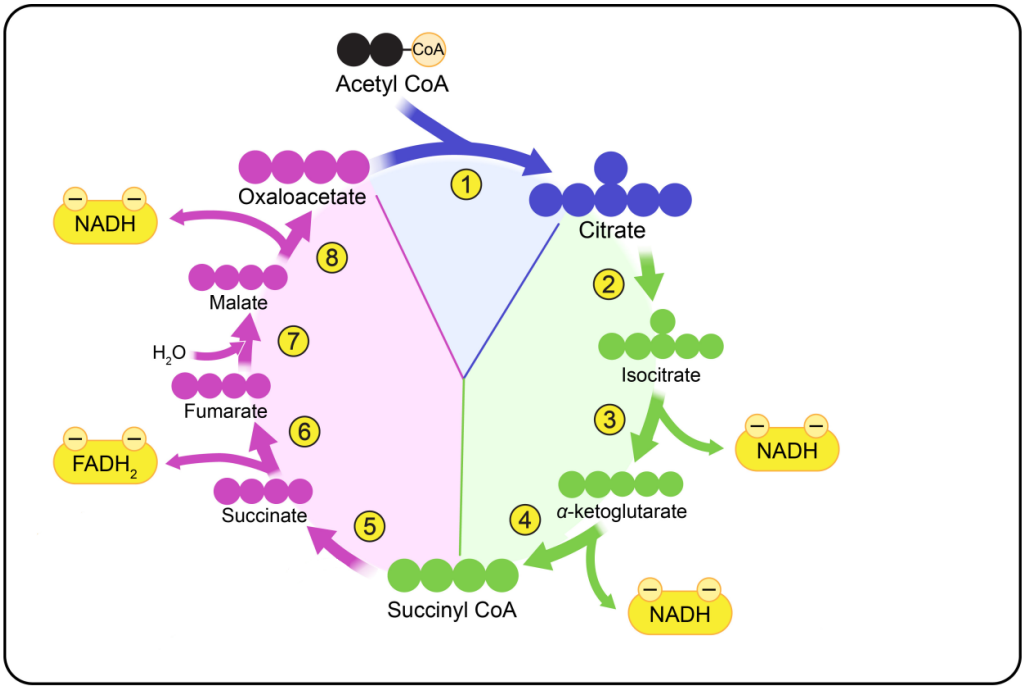
c) 2 and 4

d) 2 and 3

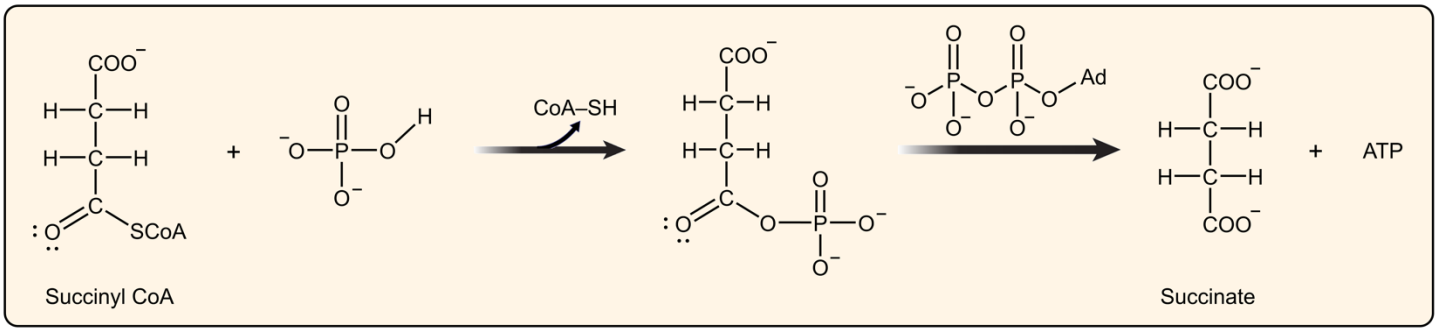
CONCEPT: THE CITRIC ACID CYCLE

Phase C – Oxaloacetate Regeneration

- Phase C consists of the pathway's reactions ___ to ___.



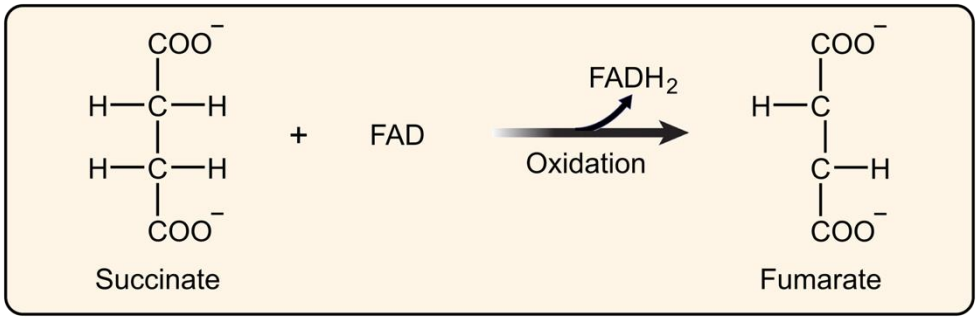
5 Hydrolysis: C1 _____ reaction of succinyl CoA followed by transfer of phosphate group to GDP.



CONCEPT: THE CITRIC ACID CYCLE

6 **Dehydrogenation:** C2-C3 dehydrogenation with FAD converts succinate to fumarate.

□ 1 FAD is reduced to 1 _____.



● FAD converts _____ bonds to _____ bonds.

EXAMPLE: Which one of the following statements is incorrect about the citric acid cycle?

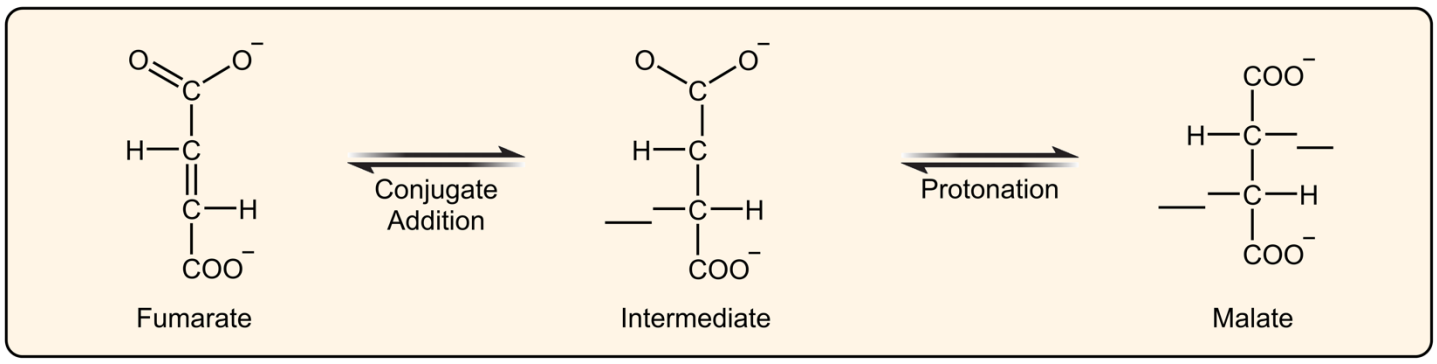
a) Reaction 5 of the cycle converts succinyl CoA to succinate.

b) Oxidation of succinate in reaction 6 produces fumarate.

c) Phase C of the citric acid cycle does not contain any oxidation reactions.

d) Hydrolysis of succinyl CoA to succinate create a high energy molecule.

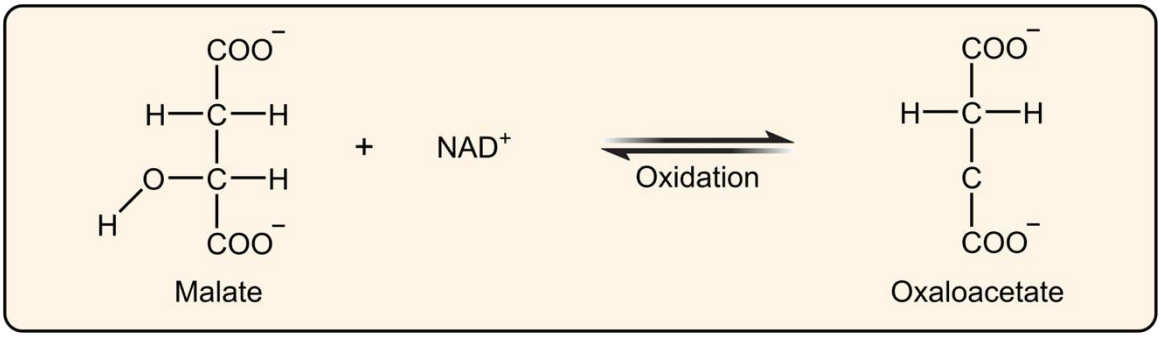
7 **Hydration:** C2-C3 conjugate addition of _____ converts fumarate to malate.



CONCEPT: THE CITRIC ACID CYCLE

8 **Oxidation:** C2 oxidation with NAD^+ to reform oxaloacetate.

□ 1 NAD^+ is reduced to 1 _____.



EXAMPLE: For each of the following reactions described below, identify a corresponding step of the citric acid cycle.

a) ____ The oxidation of malate to oxaloacetate.

b) ____ Succinate loses two H atoms to yield fumarate.

c) ____ Succinyl CoA undergoes hydrolysis to produce succinate.

d) ____ Malate is produced from hydration of fumarate.

PRACTICE: How many final high-energy molecules are produced in phase C of the citric acid cycle?

a) 2

b) 4

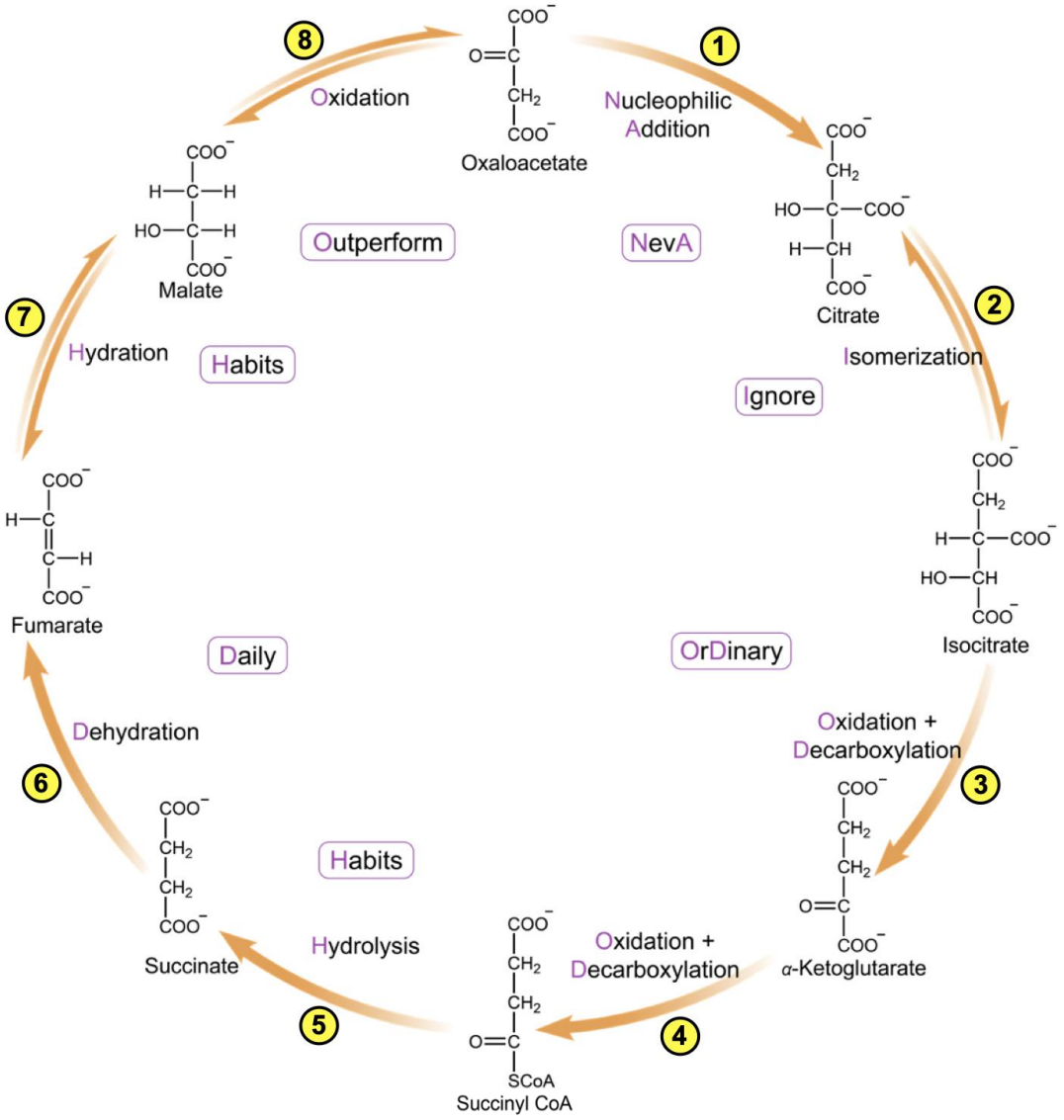
c) 1

d) 3

CONCEPT: THE CITRIC ACID CYCLE

Remembering The Citric Acid Cycle Mechanisms: Reactions 1–8

MEMORY TOOL: NevA Ignore OrDinary Habits. Daily Habits Outperform.



EXAMPLE: Which of the following reaction steps could be classified as an electrophilic addition reaction?

a) 5

b) 2

c) 7

d) 6

CONCEPT: THE CITRIC ACID CYCLE

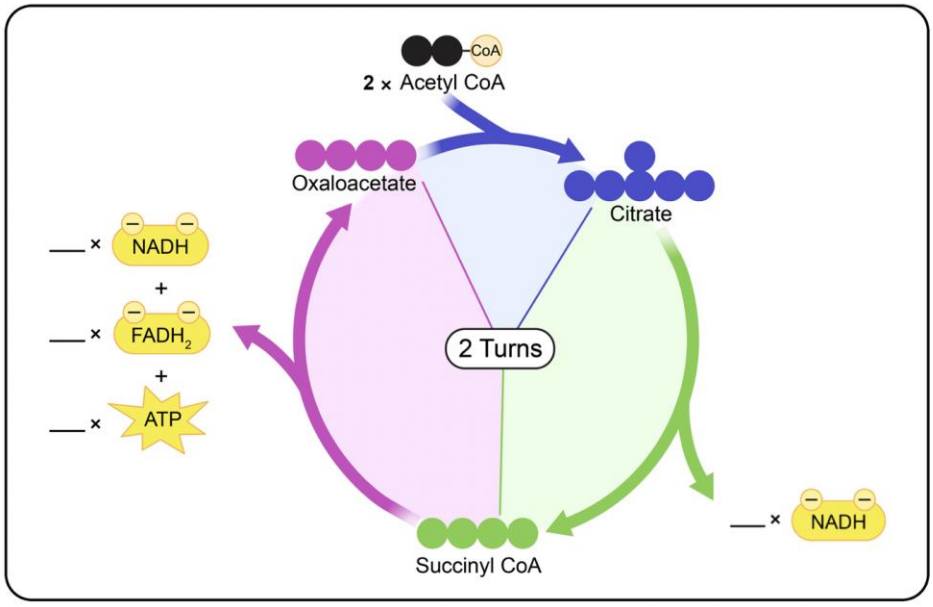
Citric Acid Cycle Summary

● The citric acid cycle degrades acetyl groups to produce _____ and high-energy molecules.

MEMORY TOOL 1: Krebs cycle is **A** **B**ig **C**rab. **MEMORY TOOL 2:** ___ Owls and __ ____ Hawk in a circus ring.

□ ___ oxidation reactions each in phases **B** and **C**.

□ Oxidation reactions yield _____ and/or _____. - Hydrolysis reaction yields _____.



	Krebs Cycle (Citric Acid)
Start Molecule	**2 Acetyl-CoA**
ATP	
$FADH_2$	
NADH	
End Molecule	**Oxaloacetate**

MEMORY TOOL 3: u____er trees in a forest, there lived 5 __nts and 6 __lies.
u____er __'s in a __ __, there lived 5 __nts and 6 __lies.

CONCEPT: THE CITRIC ACID CYCLE

EXAMPLE: How many reactions in the citric acid cycle produce high-energy molecules?

a) 4

b) 5

c) 3

d) 6

PRACTICE: Which reaction of the citric acid cycle produces NADH from the choices provided?

a) Reaction 3 b) Reaction 5 c) Reaction 2

d) Reaction 6 e) Reaction 1 f) None of these