Gluconeogenesis

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Name _____ Date _____

Read top to bottom. Counts are per glucose made (2 pyruvate in).

_____
mitochondria

1 _____ BYPASS
in _____
out _____

_____
mitochondria

OAA exits the mitochondrion as malate

2 _____ BYPASS
in _____
out _____

_____
cytosol

Glycolysis enzymes, run in reverse
in _____
out _____

_____

3 _____ BYPASS
in _____
out _____

_____

Phosphoglucose isomerase (shared)

_____

4 _____ BYPASS
in _____
out _____

_____
leaves the ER

Where the carbons come from

Lactate becomes _____

Alanine becomes _____

Glycerol enters as _____

Odd-chain fatty acids give _____

Cannot be used _____

Why not? _____

Know it

Main organs _____

Rate-limiting enzyme _____

Activated by _____

Inhibited by _____

Hormones that turn it on _____

Pyruvate carboxylase activator _____

Pyruvate carboxylase cofactor _____

Fed or fasted? _____

Total cost per glucose _____

Glycolysis steps it bypasses _____

The fructose 2,6-bisphosphate switch

High F2,6-BP (fed, insulin) : glycolysis _____

High F2,6-BP: gluconeogenesis _____

Glucagon makes F2,6-BP go _____

Connect it

Why does acetyl-CoA from fat oxidation push gluconeogenesis forward? _____

Why can't muscle release glucose made from its glycogen? _____

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Glycogen Metabolism

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Name _____ Date _____

SYNTHESIS (GLYCOGENESIS)

_____

_____
in _____
out _____

_____

_____

_____

_____
in _____
out _____

_____

_____ RATE-LIMITING
in _____
out _____

_____

bond made: _____

_____

bond made: _____

_____

BREAKDOWN (GLYCOGENOLYSIS)

_____

_____ RATE-LIMITING
in _____
out _____

_____

_____

_____

cuts at _____ branch points

_____

_____
liver only

_____
in _____
out _____

_____
muscle

Muscle keeps it: no

Know it

Main storage organs _____

Liver glycogen is for _____

Muscle glycogen is for _____

Chain bond / branch bond _____

Insulin: synthase / phosphorylase _____

Glucagon or epinephrine _____

Glucagon / epinephrine act through _____

Phosphorylation turns synthase _____

Allosteric activator of synthase _____

Activate muscle phosphorylase _____

Glucagon acts on _____

Fed or fasted (synthesis / breakdown) _____

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Fatty Acid β-Oxidation

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1 · ACTIVATE AND TRANSPORT

cytosol

in _____
out _____

cytosol

_____ RATE-LIMITING
in _____
out _____

intermembrane space

in _____
out _____

matrix

2 · ONE ROUND (IN THE MATRIX)

_____

in _____
out _____

_____

in _____
out _____

_____

in _____
out _____

_____

in _____
out _____

_____

repeat with the shorter chain

Step types (oxidation, hydration…) go on the enzyme lines.

Worked example: palmitate (C16)

Rounds of β-oxidation _____

Acetyl-CoA made _____

$FADH_2$ / NADH made _____

8 acetyl-CoA × 10 ATP _____

7 $FADH_2$ × 1.5 _____

7 NADH × 2.5 _____

Minus activation cost _____

Net ATP _____

Know it

Location _____

Rate-limiting enzyme _____

CPT-I inhibited by _____

Fed or fasted? _____

Fat released from adipose by _____

Odd-chain end product _____

Can odd-chain carbons make glucose? _____

Liver's acetyl-CoA in fasting goes to _____

Unsaturated fatty acids need _____

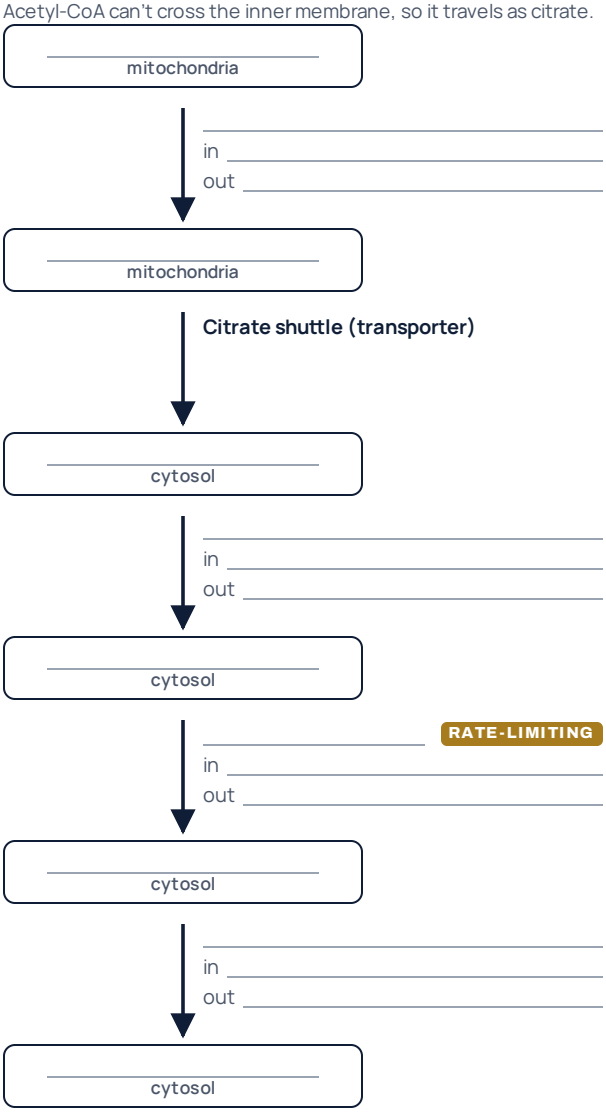
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Fatty Acid Synthesis

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Acetyl-CoA can't cross the inner membrane, so it travels as citrate.



One fatty acid synthase cycle

Step 1 _____

Step 2 _____

Step 3 _____

Step 4 _____

Carbons added per cycle _____

NADPH used per cycle _____

Cycles to make palmitate _____

Growing chain is carried on _____

Where the NADPH comes from

Main source _____

Second source _____

Know it

Location _____

Fed or fasted? _____

Activated by _____

Inhibited by _____

ACC cofactor _____

Longest chain FA synthase makes _____

Malonyl-CoA also blocks _____

COMPARE: BREAKDOWN VS. SYNTHESIS

	β-Oxidation	Fatty acid synthesis
Location		
Fed or fasted		
Rate-limiting enzyme		
2-carbon unit		
Electron carriers		
Acyl carrier		

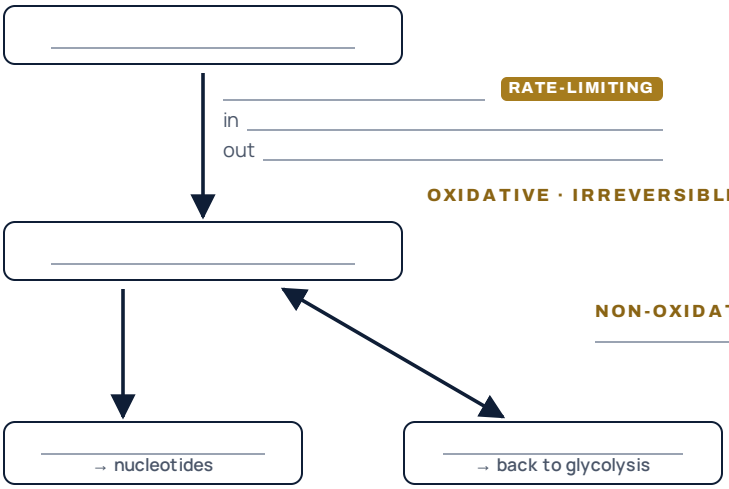
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PPP & Ketone Bodies

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Name _____ Date _____

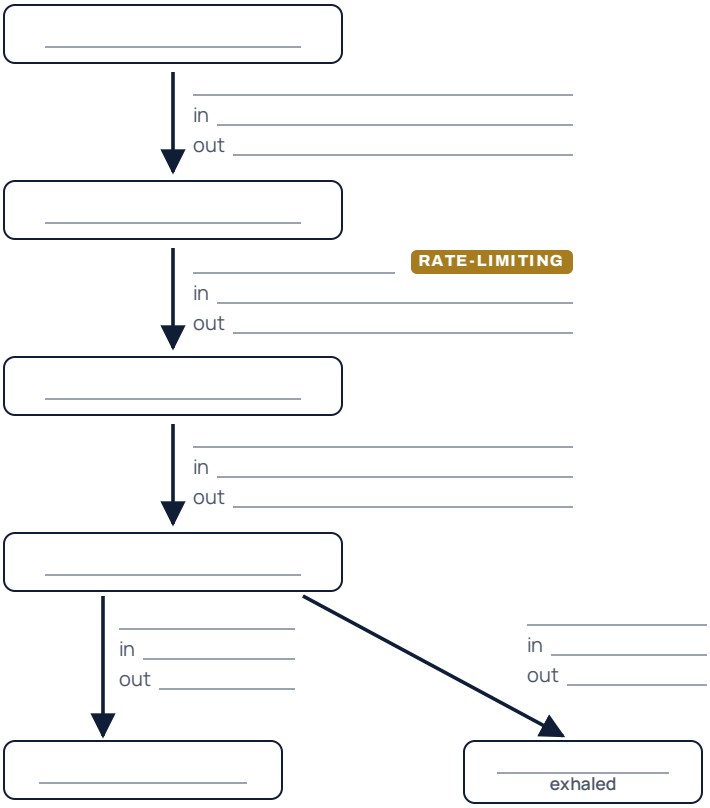
PENTOSE PHOSPHATE PATHWAY · CYTOSOL



Know it

- Rate-limiting enzyme _____
- Activated by _____
- Inhibited by _____
- NADPH is used for _____
- Ribose 5-P is used for _____
- Transketolase cofactor _____

KETONE BODIES · LIVER MITOCHONDRIA



Draw each one. Which isn't really a ketone? _____

Know it

- Made when _____
- Made in _____
- Used by _____
- Liver can't use them because it lacks _____
- Back to fuel: acetoacetate → _____
- Fed or fasted? _____

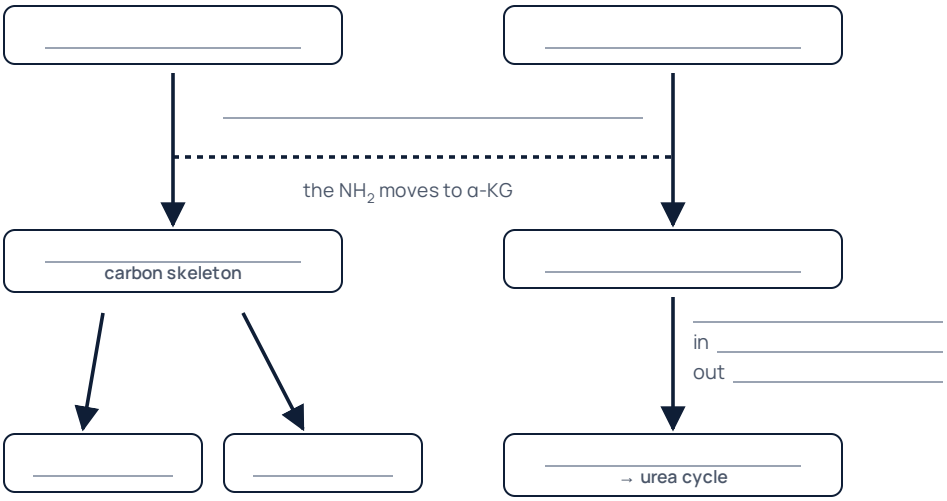
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Amino Acids & Urea

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Name _____ Date _____

REMOVING THE NITROGEN



Know it

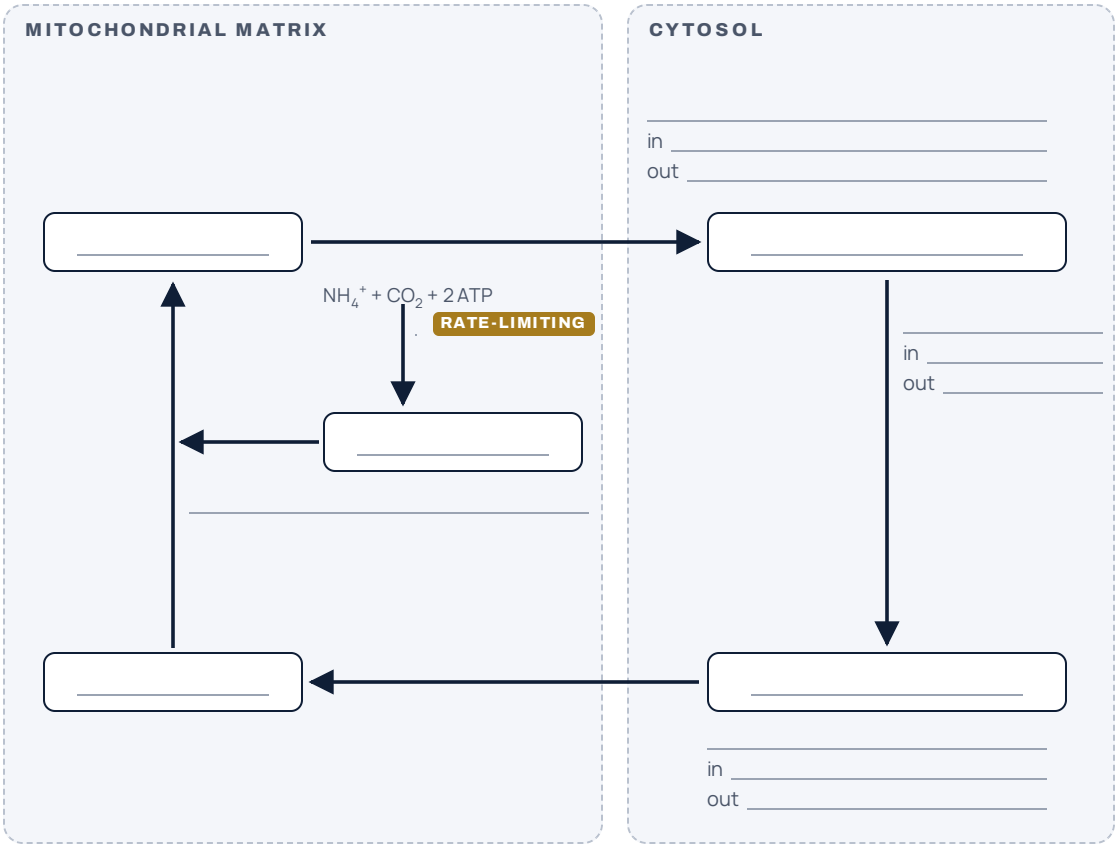
Transamination cofactor

Usual NH_2 acceptor

Purely ketogenic amino acids

Muscle ships N to liver as

UREA CYCLE · LIVER



Know it

Rate-limiting

Activator

Organ

Two N sources

ATP used

Link to TCA

Urea leaves via

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Regulation at a Glance

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Name _____ Date _____

Fill in the control point for every pathway in Parts 1 and 2. Hormones count as activators or inhibitors.

Pathway	Rate-limiting enzyme	Activated by	Inhibited by	Fed or fasted
Glycolysis				
Gluconeogenesis				
Pyruvate dehydrogenase				
Citric acid cycle				
Glycogen synthesis				
Glycogen breakdown				
Pentose phosphate				
Fatty acid synthesis				
β-Oxidation				
Ketogenesis				
Urea cycle				

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