King Saud University,
College of Science, Biochemistry Department
Final Exam,
2nd Semester 1430 H – 31H
Metabolism-1, 347 BCH **Time : 3 hours**

Student name:----------

Student number:----------

Serial No:----------

Question I	**/15**
Question II	**/15**
Question III	**/10**
Question IV	**/10**
Total	**/50**

كلية العلوم تتمنى لكم التوفيق و السداد و تؤكد على أن الدراسة ستبدأ من الأسبوع الأول للعام الدراسي القادم إن شاء الله ، و ستكون هناك درجات إضافية للحضور خلال الأسبوعين الأولين من الدراسة

Good Luck

Question I :Answer the following as true [T] or false [F]:

1. Ketones are molecules that result from fat metabolism. [ ]

2. The major product of breakdown of glycogen in the liver and muscle is free glucose. [ ]

3. Malonyl-CoA activates carnitine acyltransferase I, thereby enhancing the fatty acid catabolism [ ]

4. Both β-oxidation and the fatty acid synthesis is the exact reverse of each other [ ]

5. Ketosis/ketoacidosis results from increased ketone bodies in the blood [ ]

6. The synthesis of lipids mainly takes place in the Cytosol [ ]

7. Metabolically, the first product of fructose in the liver is fructose 6-phosphate [ ]

8. The immediate product of the degradation of glycogen by phosphorylase is glucose-1-phosphate. [ ]

9. The active form of glycogen synthase is phosphorylated; the active form of glycogen phosphorylase is dephosphorylated. [ ]

10. In diabetic subjects, fructose disappears from blood more rapidly than glucose [ ]

11. α-oxidation of fatty acids causes accumulation of phytanic acid in the brain. [ ]

12. phosphatidic acid is common intermediate in the synthesis of triacylglecerol and Sphingolipids. [ ]

13. Glycerol 3-P is formed in the adipose tissue mainly by reduction of dihydroxyacetone P. [ ]

14. In mammals, phosphatidyl choline (PC) (lecithin) is synthesized by decarboxylation of phosphatidylserine**.** [ ]

15. 3-hydroxy-3-methylglutaryl-CoA synthase is the regulatory enzyme of ketone bodies synthesis [ ]

Question II : Circle the correct answer(s) (multiple response):

1. Glycogen metabolism:

a. Branching enzyme has 2 catalytic activity

b. Liver glycogen maintain normal blood glucose concentration during early fasting

c. The main site of glycogen catabolism is cytosol of liver and kideny

d. Muscle glycogen acts as a source of energy within the muscle itself only

2. What is/are true for lipids?

a. They are polar and soluble in water.

b. They are Soluble in organic and non-polar solvents

c. Steroids, glycolipids, fatty acids, triacylglycerols, phosphoacylglycerols and sphingolipids are all examples of lipids.

d. Not essential in diet.

3. Which compounds/coenzymes belong to fatty acid synthesis and not belong to their catabolism ?

a. FAD

b. NAD+

c. NADPH

d. Acyl carrier protein (ACP)

4. Regarding denovo fatty acid biosynthesis, what is/are true?

a. The biosynthesis of fatty acids proceeds by succesive addition of two-carbon units

b. In mammals the biosynthesis is catalyzed by a large multienzyme complex

c. Fatty acid synthase complex is active as a monomer

d. Acyl carrier protein (ACP) contains the vitamin pantothenic acid

5. Can Acetyl-CoA directly be transported from the mitochondrial matrix to the cytosol?

a. No, oxaloacetate crosses the mitochondrial membrane to the cytosol and then acetyl-CoA is produced

b. No, oxaloacetate and acetyl-CoA forms citrate which travels out to the cytosol

c. Yes, acetyl-CoA is directly transferred into the cytosol

d. No, mitochondria is not permeable to acetyl CoA

6. What are the important molecules and steps directly involved in the oxidation of fatty Acids?

a. Hexokinase/Glucokinase.

b. Shuttling of fatty acyl-CoA with Carnitine

c. Lactate

d. The process starts with the activation of a fat molecule in the cytoplasm

e. Acyl-CoA-synthetase and acyl-CoA

7. Ketone bodies

a. Are formed when there is an excess of acetyl-CoA than the capacity of TCA cycle to oxidize it

b. Are formed when there is an excess of oxaloacetate in comparison to the levels of acetyl-CoA

c. Acetoacetate, acetone and β-hydroxybutyrate are all forms of ketone bodies

d. Can be used as the source of energy in liver

8. Rate limiting step of fatty acid synthesis:

a. Is catalyzed by acetyl CoA carboxylase

b. Converts acetyl CoA into malonyl CoA by carboxylation

c. Is reversible

d. Requires biotin as cofactor

9. What is/are true?

a. Since the length on fatty acids varies with the number of carbon atoms that they consist of, the number of produced molecules of acetyl-CoA will also vary.

b. The synthesis of fatty acids utilizes energy in the form of ATP

c. All lengths of fatty acids produce the same amount of energy for a cell

d. Acetyl-CoA consists of three carbon atoms so during the oxidation of a 18 carbon long fatty acid chain (stearic acid), six molecules of Acetyl-CoA will be produced

10. Regarding sphingolipids:

a. The sphingosine can form an amide bond with a fatty acid carboxyl, to yield a ceramide

b. A cerebroside is a sphingolipid containing sugar such as glucose or galactose

c. Ceramide can be converted to shingomyelin by addition of phosphoryl choline

d. Cerebrosides and gangliosides are called glycosphingolipids

11. Desaturation of fatty acids

a. Occurs in mitochondria

b. Requires oxygen, NADPH, and cytochrome b5

c. Introduce double bonds at specific positions in a fatty acid chain

d. Mammalian cells are able to produce double bonds at any location

12. Fatty acid elongation in microsomes:

a. FADH2 is used a source of reducing power

b. Occurs by addition of 2 Carbon units from Malonyl CoA

c. Fatty acids esterified to coenzyme A serve as substrates.

d. Is carried out by fatty acid synthetase complex

13. Which of the following statements regarding lipid digestion is/are true?

a. Bile salts help to emulsify fat droplets.

b. Pancreatic lipase catalyzes hydrolysis of emulsified triacylglycerols at positions 1 & 2

c. Pancreatic phospholipase A2 is s secreted as inactive zymogen by the pancreas into the intestine

d. Gastric lipase acts only on triglycerides with long chain fatty acids

14. Which of the following statements regarding lipid absorption is/are true?

a. Short chain fatty acids and glycerol pass via the portal system directly to the liver

b. Cholesterol is absorbed in free form

c. Triglycerides, phospholipids, and bile salts combine with protein forming chylomicrons

d. The products of lipid digestion are resynthesized into triacylglycerols in the intestinal mucosal cells

15. In comparing potential energy of lipids and carbohydrates, it is correct to say that lipid provide

a. considerably less energy than carbohydrates

b. considerably more energy than carbohydrates

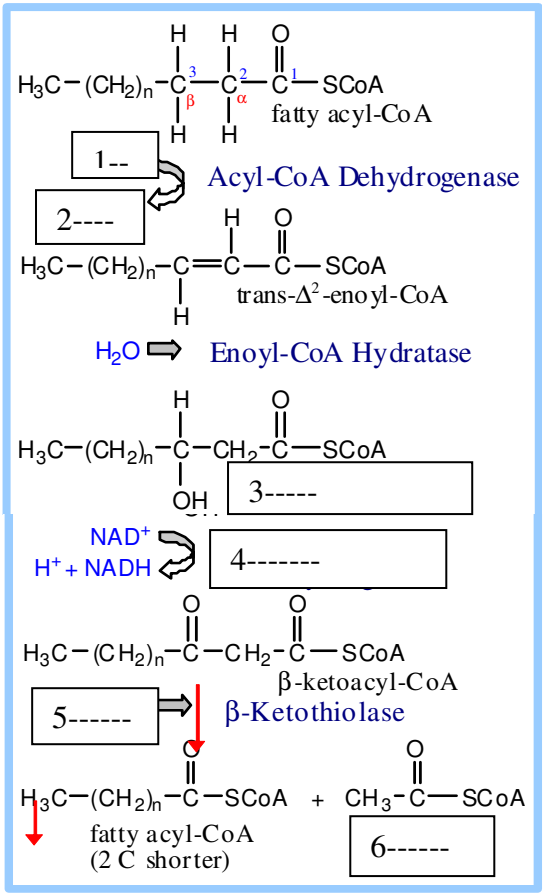
c. slightly less energy than carbohydrates

d. almost the same amount of energy as carbohydrates

Question III: Match each statement from Column A with the appropriate one from column B:

	A	B
1	Oxidation of oleate (unsaturated fatty acid) requires additional enzyme	Synthesis of hydroxy fatty acids for cerebrosides formation. ----------
2	Aldolase B	Glycogen Phosphorylase ----------
3	ATP inhibits	Enoyl-CoA isomerase ----------
4	α-oxidation of fatty acids	fructose metabolism ----------
5	Peroxisomes	Acyl CoA Synthetase (Thiokinase) --------
6	Elevated plasma fatty acids level	A hydroxylation takes place on the methyl carbon ----------
7	Fatty acid activation	Oxidation of very long chain fatty acids (C20-C22) ----------
8	The Δ^9 desaturase	Citrate ----------
9	Omega (ω) oxidation of fatty acids	Diabetes Mellitus ----------
10	Acetyl CoA carboxylase activated by	conversion of stearate (18:0) to oleate (18:1 :9) ----------

Question IV:: Label the following figures, and then answer the related questions:



A-What is this pathway?

_____

B- Label the following:

1-Coenzyme_____ 4- Enzyme_____

2- Coenzyme _____ 5-Coenzyme_____

3- Chemical compound_____ 6-Chemical compound_____

C- This pathway is increased by _____

And decreased by _____

D- Enzymes of this pathway are present in the_____

E- Mention the products of the final round of β-oxidation of odd chain fatty acids

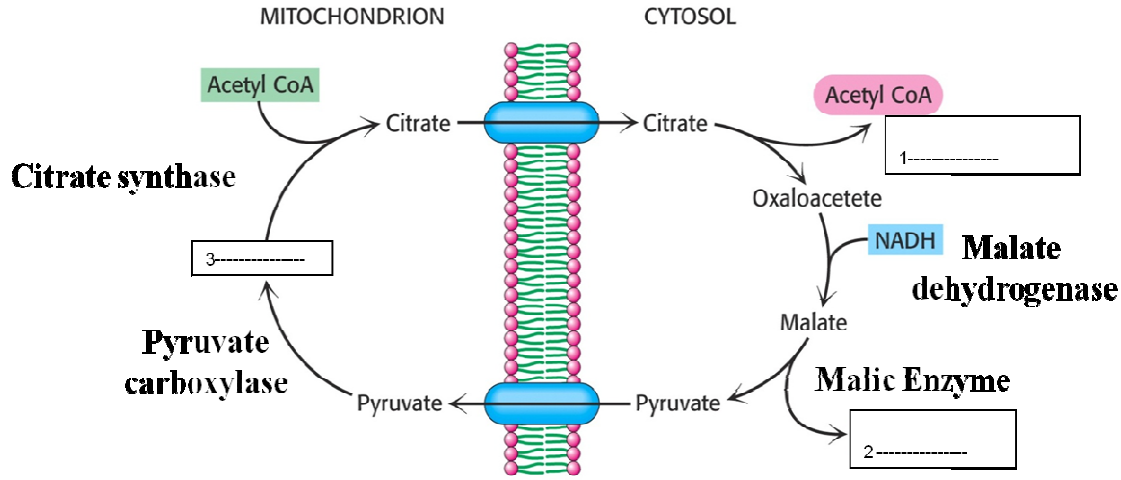
_____

F- Explain why hytanic acid undergo α- oxidation ?

_____

_____

2- Citrate-malate-pyruvate shuttle :



A-Label the followings :

1- Enzyme_____

2- Coenzyme_____

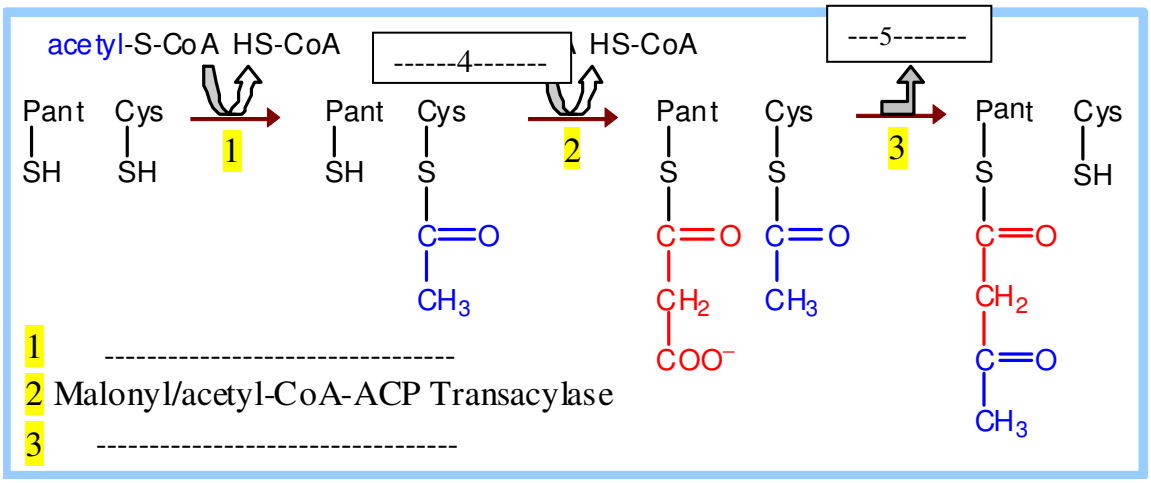
3- Chemical compound_____

B- Mention the importance of this shuttle for fatty acid synthesis

_____

_____

3- In the pathway of Denovo Fatty Acid (FA) Synthesis :



A-Label the followings:

1-Enzyme_____

3- Enzyme_____

4- Substrate_____

5- Product_____

B- Mention the sources of NADPH for fatty acid synthesis :
1-_____
2-_____
3-_____

C- Write a balanced equation for synthesis of palmitate from acetyl-CoA and malonyl Co A, listing net inputs and outputs ;

_____

_____

D- In fatty acids chain elongation in mitochondria ;

The source of the added 2 C atoms is_____

The sources of reducing power are_____