

Points

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1. Many biosynthetic reactions involve the input of energy from ATP and the reducing agent NADPH. For the lipid (fatty acid and sterol) biosynthesis reactions we have studied, identify (by giving reactants and products—structure or name) the steps in which:

(12) (a) ATP is utilized in sterol biosynthesis (3 steps).

(8) (b) NADPH is utilized in fatty acid biosynthesis (2 steps)

- (3) 2. Incorporation of [1-<sup>14</sup>C] acetate into fatty acids in crude extracts of liver is stimulated by the addition of bicarbonate ion (i.e., CO<sub>2</sub> in solution at neutral pH), and partial fractionation of the enzymes can demonstrate that bicarbonate is an essential cofactor for the process. But radioactive bicarbonate is not incorporated into the fatty acid chain. Explain these results based on what you know about fatty acid biosynthesis.

(6) 3. Describe two roles that citrate has in fatty acid biosynthesis.

(4) 4. To which *omega* class do the following fatty acids belong?

(a) alpha linolenic acid (9,12,15-C<sub>18:3</sub>)                      (b) gamma linolenic acid (6,9,12-C<sub>18:3</sub>)

(c) *cis*-vaccenic acid (11-C<sub>18:1</sub>)                                      (d) linoleic acid (9,12-C<sub>18:2</sub>)

(8) 5. Name the **disease** and the **missing enzyme** in which the following sphingolipids accumulate:

(a) Gal  $\alpha$ (1-4) Gal  $\beta$ (1-4) Glc  $\beta$ (1-1) ceramide                      (b) Gal  $\beta$ (1-1) ceramide

(c) Glc  $\beta$ (1-1) ceramide    (d) ceramide

(10) 6. Following are five characteristics of one or more of the reactions of cholesterol biosynthesis. Associate each characteristic with one or more of **five** stages of cholesterol biosynthesis from acetyl-CoA, by placing the number or numbers of the stages in the blank to the left of the characteristic: (A characteristic may be associated with more than one stage).

- \_\_\_\_\_ (a) Release of inorganic pyrophosphate
- \_\_\_\_\_ (b) Requirement for NADPH
- \_\_\_\_\_ (c) Requirement for O<sub>2</sub>
- \_\_\_\_\_ (d) Release of CO<sub>2</sub>
- \_\_\_\_\_ (e) Requirement for ATP

**Stages:**

1. acetyl-CoA → mevalonate
2. mevalonate → isopentenyl-PP
3. isopentenyl-PP → squalene
4. squalene → lanosterol
5. lanosterol → cholesterol

- (2) 7. To be classified as a **ganglioside**, a sphingolipid must contain what sugar?
8. At least seven separable proteins are involved in the biosynthesis of fatty acids in bacteria.
- (7) (a) Identify the seven by **name** or **abbreviation**. (Use the shortened names and abbreviations we used in class).
- (2) (b) Which of the proteins in (a) contains a prosthetic group to which intermediates are covalently bound?
- (2) (c) Which of the proteins in (a) contains a very reactive cysteine sulfhydryl group that participates in the reaction.
- (4) 9. What intermediate compound must cholesterol be converted to in order to form vitamin D from ultraviolet light exposure? (Name **or** structure okay)
- (6) 10. The prosthetic group for transaminases cycles between two forms. One form is covalently bound to the enzyme; the other is not covalently bound but carries the nitrogen atom that has been removed from an amino acid. Give the structure of **both forms**, showing the covalent linkage to the enzyme for the first form.

- (8) 11. The biosynthesis of urea requires ATP at two steps. Identify these steps by giving the **reactants** and **products** (names or structures) and the **name of the enzymes**.
- (8) 12. The nitrogen atoms for urea synthesis come from glutamic acid. Identify the **two** reactions in which glutamate is involved in giving up its nitrogen for this cycle. (Give **reactants** and **products** –name or structure—and the **name of the enzymes**).
- (6) 13. The urea cycle contains three amino acids not found as a component of proteins. Give the **name** and **structure** of **two** of these amino acids that must cross the mitochondrial membrane as part of the cycle.
- (4) 14. The biosynthesis of triglycerides and phospholipids begins with the reduction of dihydroxy acetone phosphate to glycerol phosphate.
- (a) What phospholipid is initially formed from glycerol phosphate?
- (b) What nucleotide is utilized to activate the intermediates for synthesis of other phospholipids from the initial one?