

BML 221: METABOLISM OF BIOMOLECULES (PAPER 1)

SECTION A

1. A lipase breaks a triacylglycerol molecule down into
 - (a) 2-monoacylglycerol plus one fatty acid.
 - (b) 2-monoacylglycerol plus two fatty acids.
 - (c) Acetyl-glycerol plus two fatty acids.
 - (d) 2-monoacylglycerol plus three fatty acids.

2. In the urea cycle, the first amide group to enter the cycle
 - (a) Enters as ammonium ion.
 - (b) Is activated by attachment of a phosphate from the cleavage of ATP.
 - (c) Is provided by aspartate.
 - (d) Forms ornithine.

3. The synthesis of a pyrimidine requires
 - (a) Glutamine, carbamoyl sulfate, and aspartate.
 - (b) Glutamine, carbamoyl phosphate, and aspartate.
 - (c) Glycine, carbamoyl phosphate, and aspartate.
 - (d) An imidazole ring, glutamine, carbamoyl phosphate, and aspartate.

4. A pyrimidine that can be used to make other pyrimidine bases is
 - (a) Uracil.
 - (b) Thymine.
 - (c) Guanine.
 - (d) Adenosine.

5. Orotic acid is synthesized into
 - (a) Cytosine.
 - (b) Imidazole.
 - (c) Thymine.
 - (d) Uracil.

6. A noncompetitive enzyme inhibitor differs from a competitive enzyme inhibitor in which way?
 - (a) There are no significant differences.
 - (b) A noncompetitive inhibitor works well at low and high concentrations of substrate. A competitive inhibitor does not work well at low concentrations of substrate.
 - (c) A noncompetitive inhibitor works well at low and high concentrations of substrate. A competitive inhibitor does not work well at high concentrations of substrate.

(d) A competitive inhibitor causes K_m to decrease, while a noncompetitive inhibitor causes K_m to increase.

7. If a cell needs to continue using glycolysis for energy, it must replenish its supply of

- (a) NAD⁺ molecules.
- (b) NADH molecules.
- (c) Protons.
- (d) H⁺ molecules

8. In the pay-off phase of glycolysis, the total number of ATP molecules produced is

- (a) 1.
- (b) 2.
- (c) 4.
- (d) 6

9. In the citric acid cycle

- (a) All steps are exergonic.
- (b) All steps except 2 are exergonic.
- (c) All steps except 2 are endergonic.
- (d) All steps are endergonic.

10. Isocitrate dehydrogenase

- (a) Is activated by high concentrations of ATP and NADH.
- (b) Is activated by high concentrations of ATP and NADPH.
- (c) Is unaffected by high concentrations of NADPH.
- (d) Is inhibited by high concentrations of high-energy compounds.

11. In the electron transport chain, complex II

- (a) Does not contribute to the proton gradient, but mediates the transfer of electrons from succinate to cytochrome a.
- (b) Does not contribute to the proton gradient, but mediates the transfer of electrons from succinate to cytochrome c.
- (c) Does not contribute to the proton gradient, but mediates the transfer of electrons from succinate to coenzyme Q.
- (d) Contributes to the proton gradient, and mediates the transfer of electrons from succinate to coenzyme Q.

12. An Antagonist is best described by which of the following?

- (a) It can bind to a hormone receptor, preventing a hormone from binding to a cell and producing other, unexpected effects.
- (b) It can bind to a hormone receptor, preventing a hormone from binding to a cell and thereby the effect of the hormone is absent.
- (c) It is a compound which blocks the action of an agonist.
- (d) It is a compound which acts to degrade a hormone.

13. Mitochondrial DNA is useful in determining relationships between groups because

- (a) It is single stranded.
- (b) It is inherited strictly from the mother.
- (c) It does not contain mutations.
- (d) All of the above are correct

14. The enzyme *glucokinase*

- (a) Is found only in the liver, and is inhibited by glucose 6-phosphate.
- (b) Is found only in the skeletal muscle, and is inhibited by glucose 6-phosphate.
- (c) Is found only in the skeletal muscle, and is not inhibited by glucose 6-phosphate.
- (d) Is found only in the liver, and is not inhibited by glucose 6-phosphate

15. Which of the following statements is **not** true?

- (a) Pyruvate is converted to ethanol by yeast cells.
- (b) Pyruvate is converted to ethanol using pyruvate decarboxylase and alcohol dehydrogenase.
- (c) Pyruvate can be converted to ethanol in human muscle cells, but only under very restrictive conditions.
- (d) Pyruvate cannot be converted to ethanol in mammalian cells.

16. The formation of a single molecule of urea requires the cleavage of

- (a) One molecule of ATP.
- (b) Three molecules of ATP.
- (c) Four molecules of ATP.
- (d) Six molecules of ATP.

17. Phenylketonuria

- (a) Is due to insufficient phenylalanine in the diet.
- (b) Is due to inability to correctly incorporate nitrogen into the α -keto acid precursor to phenylalanine.
- (c) Is due to an inability to produce tyrosine.

(d) Is an example of starvation in the face of adequate caloric intake.

18. 2,3-BisPhosphoG affects adaptation to high altitude by

- (a) Increasing hemoglobin's ability to absorb oxygen from the atmosphere.
- (b) Improving oxygen delivery to the tissues.
- (c) Causing dilation of capillaries.
- (d) All of the above are correct.

19. High-density lipoprotein (HDL)

- (a) Only transports cholesterol in the bloodstream.
- (b) Transports cholesterol to the kidneys.
- (c) Releases cholesterol from the liver.
- (d) Transports cholesterol from the tissues to the liver.

20. Protein function can be deduced using

- (a) DNA microarrays.
- (b) Antisense technology.
- (c) Analogy with proteins of similar structure.
- (d) All of the above are correct.

SECTION B

1. Describe the role and significance of glutamate dehydrogenase (8mks)

2. Discuss the properties and distribution of Glucose transporters (GLUT1, 2, 3, 4 and 5) (8mks)

3. What happens when excretion of ammonia is deranged? (8mks)

4. Describe β -oxidation of Pentadecanoic acid (C15:0). (8mks)

5. Explain the Malate-Aspartate shuttle (8mks)

SECTION C

1(a). Describe the essential features of the urea cycle (12mks)

(b). Explain how the regulation of the Urea Cycle takes place in the body (8mks).

2. Discuss Gluconeogenesis (20mks)

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SECTION A

1. The following amino acids are derived from glutamate, except?
 - (a) Serine.
 - (b) Cysteine.
 - (c) Methionine.
 - (d) All of the above
2. A pyrimidine that can be used to make other pyrimidine bases is
 - (a) Uracil.
 - (b) Thymine.
 - (c) Guanine.
 - (d) Adenosine
3. GTP is synthesized in the citric acid cycle
 - (a) In the transformation of succinyl-CoA to succinate.
 - (b) In the transformation of succinate to fumarate.
 - (c) In the transformation of succinate to succinyl-CoA.
 - (d) GTP is *not* synthesized in the citric acid cycle.
4. If the degree of inhibition of an enzyme is unaffected by the concentration of substrate we say that
 - (a) Competitive inhibition exists.
 - (b) Non-competitive inhibition exists.
 - (c) Pure noncompetitive inhibition exists.
 - (d) Uncompetitive inhibition exists.
5. An **apoenzyme** is
 - (a) An enzyme that does not require a cofactor.
 - (b) An enzyme that requires a *bound* cofactor.
 - (c) An enzyme that requires a cofactor, which is *not* bound.
 - (d) An enzyme that requires an *organic* cofactor.
6. The enzyme pyruvate kinase
 - (a) Is activated by fructose, and inhibited by ATP.
 - (b) Is activated by ATP, and inhibited by fructose 1,6-biphosphate
 - (c) Is activated by fructose 1,6-biphosphate and is inhibited by ATP.
 - (d) Is inhibited by fructose 1,6-biphosphate.
7. The activity of phosphofructokinase
 - (a) Is enhanced by ADP or AMP and inhibited by ATP and NADH.
 - (b) Is enhanced by ADP or AMP and inhibited only by ATP.
 - (c) Is inhibited by ADP and enhanced by ATP.
 - (d) Is inhibited by ADP and enhanced by NADH

8. The role of aspartate in the urea cycle is best described as

- (a) Serves as an intermediate.
- (b) Donates an amine to α -ketoglutarate.
- (c) Donates an amine to the final product.
- (d) Provides energy.

9. The carbon atoms of acetyl-CoA in the TCA cycle:

- (a) Are lost as CO_2 molecules.
- (b) Are recycled with oxaloacetate.
- (c) Play no role in the reaction.
- (d) Are donated to succinate dehydrogenase.

10. In an exergonic reaction:

- (a) Bonds being formed are the same strength as bonds being broken
- (b) Bonds being formed are stronger than bonds being broken
- (c) Energy is absorbed from the surroundings
- (d) Energy is released to the surroundings

11. Two enzymes within a single organism that catalyze the same chemical reaction but have catalytically distinct subunits are called:

- (a). Apoenzymes (b). Holoenzymes
- (c). Coenzymes (d). Isozymes

12. Which of the following enzymatic reactions is an example of substrate level phosphorylation?

- (a). Hexokinase (b). Glucokinase
- (c). Phosphofructokinase (d). Phosphoglycerate kinase

13. Enolase catalyzes which of the following types of reactions?

- (a). Dehydration (b). Hydrolytic
- (c). Reduction (d). Phosphorylation

14. Which of the following reactions is not a control point in the citric acid cycle?

- (a). Citrate synthase
- (b). Isocitrate dehydrogenase
- (c) α -Ketoglutarate dehydrogenase
- (d). Malate dehydrogenase

15. During fatty acid biosynthesis, the eukaryotic cell requires a lot of acetylCoA. Where does the cell get most of the required acetyl-CoA?

- (a). From the nucleus
- (b). From the mitochondria
- (c). From the golgi apparatus
- (d). All of the above

16. Which of the following is considered a committed step in fatty acid biosynthesis?

- (a). The production of acetate
- (b). The production of malonylCoA
- (c). Transcarboxylation of lysine
- (d). All of the above

17. How many mevalonate molecules are needed to make one squalene?

- (a). 1
- (b). 2
- (c). 4
- (d). 6

18. DNA polymerase has which of the following functions?

- (a). 3' to 5' polymerase activity
- (b). 3' to 5' exonuclease activity
- (c). 5' to 3' polymerase activity
- (d). BandC

19. **Pyruvate carboxylase is regulated by**

- (a) Induction (b) Repression
- (c) Allosteric regulation (d) All of these

20. **All of the following are required for synthesis of alanine except**

- (a) Pyruvate (b) α -ketoglutarate
- (c) Glutamate (d) Pyridoxal phosphate

SECTION B

1. Explain the hormonal regulation of glycolysis (8mks)
2. Compare and contrast hepatic hexokinase and extra-hepatic hexokinase(8mks)
3. Discuss the clinical significance of HMP-shunt(8mks)
4. Explain how organs are nourished during starvation(8mks)

5. Explain the regulation of purine synthesis(8mks)

SECTION C

1. Discuss urea cycle disorders(20mks)
2. Describe Glycolysis in the liver (20mks)