PRINT your Name_____Student No._____ (FAMILY, first name)

BIOCHEMISTRY 311A **VERSION 1 (ONE)**

Midterm

7:00 P.M.

Examiners: Dr. R. E. MacKenzie (69%)
Dr. A. Storer (18%)
Dr. W. Mushynski (13%)

READ THE QUESTIONS CAREFULLY!!

Each question in Sections I , II and III is worth TWO points. Answers are to be scored CAREFULLY on the computer sheet provided (FILL the circles in pencil).

- Calculators are not permitted.

- Print your name on those pages where indicated.

- Multiple Choice 60 points
  Short Answer 40 points
  100 points TOTAL

DO NOT TURN THE PAGE UNTIL INSTRUCTED !

SECTION I

Each of the questions or statements below is followed by five suggested answers or completions. Select the one which is <u>BEST</u> in each case, and then on the answer card blacken the appropriate brackets with the corresponding number.

1. Under conditions of low blood glucose, which of the following is increased ?
    1. muscle PFK-2 (phosphorylated form)
    2. liver aldolase
    3. liver phosphorylase kinase a
    4. muscle phosphorylase a
    5. none of the above

2. The major allosteric **activator** of phosphofructokinase-1 (PFK-1) in liver is:
    1. AMP
    2. cAMP
    3. ATP
    4. citrate
    5. fructose-2,6-bis P

3. Which one of the following statements about **this** glycogen molecule is **true** ?
    1. residue A can be removed by phosphorylase.
    2. glycogen synthase can add a glucosyl residue to residue B.
    3. On further degradation, residue C will ultimately be released as a molecule of glucose.
    4. On further degradation, residue D will ultimately be released as a molecule of G-1-P
    5. this molecule cannot be degraded further.

4. Which of the following is a true statement about the metabolism of galactose ?
    1. the galactose level in blood after an overnight fast is about 5 mM ($5x10^{-3}$ M)
    2. dietary galactose is required for formation of milk lactose by lactating females.
    3. galactose intolerance is due to a defect in a type of aldolase.
    4. synthesis of galactose residues in tissues requires UDP-glucose.
    5. UDP-galactose-4-epimerase is found only in liver.

5. Which of the reactions of the citric acid cycle is catalyzed by an intrinsic membrane protein?
    1. Aconitase
    2. "-Ketoglutarate dehydrogenase
    3. Citrate synthase
    4. Succinate dehydrogenase

SECTION II

For each of the statements/questions below, ONE or MORE of the completions are correct. Decide which completion or completions is/are correct and blacken the appropriate number.

(1) If only A, B and C are correct
(2) If only A and C are correct
(3) If only B and D are correct
(4) If only D is correct
(5) If all are correct

7. An animal has just been given an infusion of glucagon. Which of the following enzymes **in muscle** will become phosphorylated?
A. glycogen phosphorylase
B. phosphofructokinase II
C. glycogen synthase
D. None of the above

8. Dietary galactose is metabolized by the liver. Which of the following enzymes is/are **NOT** required for its conversion to muscle glycogen?
A. galactokinase
B. glucose-6-Phosphatase
C. UDPgalactose-4-epimerase
D. pyruvate kinase

9. The following are true statements about glycolysis.
A. the committed step is glucose **6** glucose-6-P
B. lactate and pyruvate are in equilibrium
C. hexokinase has a higher K_M for glucose than does glucokinase
D. the level of type II hexokinase is reduced in diabetic individuals

10. The following enzymes use NAD as cofactor
A. glyceraldehyde-3-phosphate dehydrogenase
B. UDP-galactose-4-epimerase
C. lactate dehydrogenase
D. glucose-6-phosphate dehydrogenase

11. The following pairs of metabolites are in thermodynamic equilibrium, ie the actual)G = 0:
A. glucose-6-P and glucose-1-P
B. glyceraldehyde-3-P and phosphoenolpyruvate
C. glucose-6-P and fructose-6-P
D. glucose and glucose-6-P

12. In the citric acid cycle, reducing equivalents are formed at:

A. Isocitrate dehydrogenase.
B. Succinate dehydrogenase.
C. Malate dehydrogenase

14. Select the true statements about glycogen metabolism:

A. elevated glucose promotes conversion of phosphorylase a to phosphorylase b in muscle

B. [phosphorylase] is 10x [phosphoprotein phosphatase] in liver

C. a glycogen molecule has only one glucose residue with a free 4' -hydroxyl group

D. in a well fed individual, there are more grams of glycogen stored in muscle than in liver

E. ***SECTION III***

Each of the lists below contain possible responses for the group of questions immediately following it. Select the best answer for each question. A given response may be used more than once or not at all.

For questions 15 to 19:

1. Inorganic phosphate
2. NAD
3. NADP
4. Thiamine pyrophosphate
5. No correct answer

15.Required by glycogen phosphorylase

16.A cofactor for triose phosphate isomerase

17.Used by 6-phosphogluconate dehydrogenase

18.Required by UDP-Glucose pyrophosphorylase (UDP-Glucose synthesis)
19.A cofactor for transketolase

For questions 20 to 25: 1." -1,4 - 1,6- glucosyltransferase
2. Amylo-1,6-glucosidase
3. Glyceraldehyde-3-P dehydrogenase
4. Pyruvate kinase
5. No correct answer

20. A defect in this could cause an excess accumulation of glycogen in liver

21.Is involved in glycogen degradation

22.This enzyme catalyzes a reaction at equilibrium in liver (ie)G=0)

23.Is regulated by phosphorylation in liver

24.Uses inorganic phosphate (Pi)

25.One subunit of this enzyme is called calmodulin

For questions 26 to 30 : 1. Muscle
2. Liver
3.Muscle and liver
4. Neither tissue

21.Pyruvate kinase is regulated by cAMP dependent protein kinase

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SECTION IV

ANSWER THE FOLLOWING QUESTIONS ON THE EXAM PAPER

1. Triose phosphate isomerase catalyzes the interconversion of glyceraldehyde-3-phosphate (GAP) and dihydroxyacetone phosphate (DHAP)

(6)

(a)In the space below draw the reaction mechanism of this enzyme:

(b)Name the type of intermediate formed in the reaction described above:

2.The enzyme phosphoglycerate mutase catalyzes the conversion of 3-phosphoglycerate (3PG) to 2-phosphoglycerate (2PG):

(6)

3.The multienzyme complex pryuvate dehydrogenase contains three catalytic activities, i.e. pyruvate dehydrogenase, dihydrolipoyl transacetylase, and dihydrolipoly dehydrogenase. List three catalytic advantages afforded by multienzyme complexes:

(6)

(a)

(b)

(c)

4.Use a diagram to outline the regulation of glycolysis in liver under low blood glucose conditions.

(15)

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5. Outline the regulation of NAD^+-dependent isocitrate dehydrogenase activity in mitochondria

(4)

6.List the names of cytoplasmic enzymes (pathways) that might be affected by citrate that is transported out of mitochondria.

(3)