

Name _____

Student number _____

University of Guelph
Department of Chemistry and Biochemistry
19-356
Structure and Function In Biochemistry

Final Exam, April 22, 1998.

Time allowed, 120 min.

Answer questions 1-30 on the computer scoring sheet provided.

Only one option is correct for each of these questions.

Use pencil to fill in the circles representing your chosen answer; and erase cleanly if you make an error. Do not use ink or white-out on the computer scoring sheet.

You may mark your answer on the question paper for your own records, however in case of a discrepancy between question paper and the computer scoring sheet, the choice shown on the computer sheet will be taken as final.

Answer questions 31-34 directly on the question paper.

Questions 1-30 have a weight of 1 mark each

30 marks

Questions 31-34 have marks as indicated

30 marks

=====

60 marks

31	32	33	34	
/ 9	/ 6	/ 8	/ 7	/ 30

Name _____

Student number _____

Answer questions 1-30 on the computer scoring sheet.

Value 1 mark each

1. Which of the following properties of hemoglobin is **not** part of the Bohr effect?
A) Decreased O₂ binding at lower pH.
B) Protonation of histidines near the C-terminus of globin.
C) Decreased O₂ binding in presence of elevated CO₂ levels.
D) Decreased O₂ binding at high altitude.
E) Formation of carbamate derivatives at the N-terminus of globin.
1) A B C D E
2. Glycogen phosphorylase is an allosteric enzyme with T and R states; which of the following is **not** true?
A) Phosphorylase **a** is preferentially in R state without requiring allosteric effectors.
B) Phosphorylase **b** is preferentially in T state in the presence of Glucose-6-P.
C) Muscle phosphorylase **b** is preferentially in T state in the presence of 5' AMP.
D) Phosphorylase **b** is preferentially in T state in the presence of ATP.
E) Liver Phosphorylase **a** is preferentially in T state in the presence of Glucose.
2) A B C D E
3. Which enzyme is **not** a component of fatty acid synthase I?
A) Condensing enzyme B) Acetyl CoA carboxylase
C) Thioesterase D) Malonyl Transferase
E) Hydroxyacyl dehydratase
3) A B C D E
4. Which of the following **sugar phosphates** is **not** a substrate or product of transaldolase?
A) Sedoheptulose-7-P B) Glyceraldehyde-3-P C) Ribose-5-P
D) Erythrose-4-P E) Fructose-6-P
4) A B C D E
5. Which of the following is **not** a positive or negative allosteric regulator of phosphofructokinase?
A) Citrate B) Fructose-2,6-bisphosphate C) ATP
D) 5' AMP E) Glucose
5) A B C D E
6. The balance of various ionic substance inside and outside cells is quite characteristic. Which of the following ionic conditions would be **abnormal**?
A) [Ca²⁺] lower inside B) [phosphate esters] lower inside
C) [Na⁺] lower inside D) [Mg²⁺] higher inside
E) [K⁺] higher inside
6) A B C D E
7. Which of the following properties or actions of the pentose phosphate pathway is **untrue**?
A) Causes CO₂ release from glucose without directly consuming O₂.
B) Generates NADPH for reduction in biosynthetic pathways
C) Interconverts different forms of sugar phosphates
D) Generates ribose-5-P for nucleotide synthesis
E) Generates ATP via oxidative phosphorylation of NADPH.
7) A B C D E

Name _____

Student number _____

8. Which of the following lipids has **net negative charge**?
- A) Phosphatidyl choline B) Phosphatidyl serine
C) Phosphatidyl ethanolamine D) Triacylglycerol
E) Diacylglycerol
- 8) A B C D E
9. The coenzyme generally **required for carboxylation** reactions is:
- A) Thiamine pyrophosphate B) NAD⁺ C) Biotin
D) Coenzyme A E) NADPH
- 9) A B C D E
10. Which factor is **beneficial if injected within 30 minutes** into a stroke victim?
- A) Vitamin K B) Fibrinogen C) Tissue plasminogen activator
D) Factor VIII E) Factor IX
- 10) A B C D E
11. Which substance is **beneficial as a preventative** of stroke?
- A) Vitamin K B) Warfarin C) Prothrombin
D) Factor VIII E) Factor IX
- 11) A B C D E
12. Which of the following substances **can be transported across membranes by simple diffusion**?
- A) Glucose B) ATP C) Simple amino acids
D) CO₂ E) K⁺
- 12) A B C D E
13. Nitrotyrosine is a modification of natural tyrosine formed by exposure to tetranitromethane, and has the following effect in aspartate transcarbamylase:
- A) Causes breakup of ATCase into c₃ and r₂ components.
B) Allows c₃ and r₂ components to rejoin into c₆r₆.
C) Causes a shift to the R state.
D) Causes a decrease in sedimentation coefficient.
E) Changes absorbance in response to change from T to R.
- 13) A B C D E
14. During intense physical activity:
- A) the liver synthesizes fatty acids from glucose.
B) the liver recycles lactate from blood into glucose.
C) the liver carries out glycolysis to make ATP which can be sent to the muscles.
D) the liver synthesizes glucose from stored fatty acids.
E) the liver takes up excess glucose from blood.
- 14) A B C D E
15. The carrier of carboxylate groups in CoA and ACP is:
- A) phosphopantotheine B) pyridoxal phosphate C) biotin
D) ATP E) thiamine pyrophosphate
- 15) A B C D E

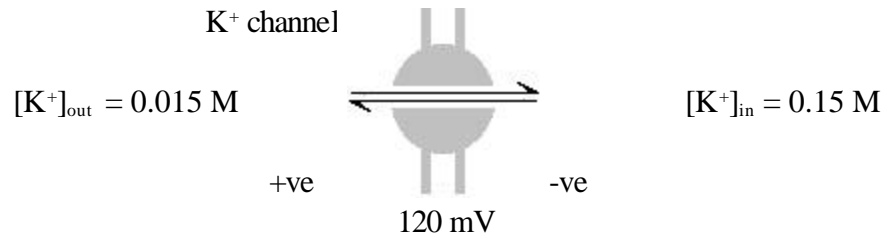
Name _____ Student number _____

16. Conversion of **pyruvate into PEP** has the following net effect:
(treat ATP and GTP as equivalent for these purposes)
A) Consumes one ATP, makes one NADH
B) Consumes two ATP, makes one NADH
C) Consumes one ATP and one NADH
D) Consumes two ATP and one NADH
E) Consumes two ATP, no net change in overall NADH. 16) A B C D E
17. The body's **primary reserve** of energy is in the form of:
A) ATP
B) proteins
C) triacylglycerols
D) glucose
E) glycogen 17) A B C D E
18. The body's **second reserve** of energy is in the form of:
A) ATP
B) proteins
C) triacylglycerols
D) glucose
E) glycogen 18) A B C D E
19. After several hours **without food**:
A) Epinephrine is released to maintain blood glucose levels.
B) Glucagon is released to maintain blood glucose levels.
C) Insulin is released to maintain blood glucose levels.
D) Insulin stimulates fat breakdown to replace glucose.
E) Glucagon stimulates glycolysis rates in liver. 19) A B C D E
20. **The brain uses glucose primarily for:**
A) Fatty acid biosynthesis.
B) To store as glycogen.
C) Energy to maintain ion gradients.
D) To make ATP to supply to muscles.
E) Pentose phosphate pathway. 20) A B C D E
21. **Which of the following effects happens after caffeine ingestion:**
A) Persistently elevated cyclic AMP levels.
B) Protein phosphatase activated.
C) Glycogen synthesis activated.
D) Adenylate cyclase activated.
E) Glycogen phosphorylase activity reduced . 21) A B C D E
22. Isocitrate dehydrogenase is under allosteric control by:
A) Activation by ADP
B) activation by ATP
C) Activation by citrate
D) activation by acetyl CoA
E) Activation by cyclic AMP 22) A B C D E

Name _____ Student number _____

23. Pyruvate carboxylase is under allosteric control by:
- A) Activation by ADP
 - B) activation by glucose-6-P
 - C) Activation by citrate
 - D) activation by acetyl CoA
 - E) Activation by cyclic AMP
- 23) A B C D E

24. The Nernst equation allows one to calculate membrane potential: for any monovalent cation, the predicted equilibrium membrane potential is 60 mV for a concentration ratio of 1 to 10. The system illustrated below contains an ion selective channel for K^+ .



Predict what happens if the ion channel opens under the conditions shown above:

- A) K^+ does not cross because the potential opposes the concentration gradient.
 - B) K^+ crosses outwards towards the higher potential.
 - C) K^+ crosses outwards towards the lower $[K^+]$.
 - D) K^+ crosses inwards because of the large membrane potential.
 - E) K^+ crosses inwards because of the concentration gradient.
- 24) A B C D E
25. **People who live at altitude adapt to lower pO_2 by:**
- A) Making less 2,3-bisphosphoglycerate to increase O_2 affinity in the lungs.
 - B) Making more 2,3-bisphosphoglycerate to increase O_2 affinity in the lungs.
 - C) Making less 2,3-bisphosphoglycerate to enhance O_2 release in capillaries.
 - D) Making more 2,3-bisphosphoglycerate to enhance O_2 release in capillaries.
 - E) By using fetal hemoglobin.
- 25) A B C D E

26. **Which is the major hemoglobin form made in the embryo during the first month after conception?**

A) $\alpha_2\beta_2$ B) $\alpha_2\varepsilon_2$ C) $\varepsilon_2\zeta_2$ D) $\alpha_2\delta_2$ E) $\varepsilon_2\beta_2$ 26) A B C D E

27. **Activation of chymotrypsinogen by trypsin involves**

- A) Release of a peptide that blocks access to the active site.
- B) Phosphorylation of a critical serine.
- C) Binding of calcium to g-carboxyglutamate.
- D) Binding of ATP
- E) Cleavage of a peptide bond to create a positive charged N-terminal Isoleucine.

27) A B C D E

Name _____

Student number _____

28. **Fibrinogen** is prevented from clotting by **negative charge in its central region; part of this negative charge is due to the modified amino acid:**
A) tyrosine-O-sulfate B) Serine-O-phosphate C) γ -carboxyglutamate
D) nitrotyrosine E) threonine-O-phosphate
28) A B C D E
29. **The product of 6-phosphogluconate dehydrogenase is**
A) 6-phosphogluconolactone B) glucose-6-P C) ribose-5-P
D) ribulose-5-P E) xylulose-5-P
29) A B C D E
30. **The normal final product released by human fatty acid synthase I is**
A) $C_{16}H_{33}CO_2^-$ B) $C_{15}H_{31}CO_2^-$ C) $C_{17}H_{35}CO_2^-$
D) $C_{15}H_{31}COSCoA$ E) $C_{17}H_{35}COSCoA$
30) A B C D E

Name _____

Student number _____

31. Explain what is meant by **symport** and **antiport**, and give an example of a specific **antiport** process in the mitochondrial membrane.

symport:

antiport:

example:

What process do cells use to import glucose across the cell membrane? What makes it possible to move glucose from low external [glucose] to high internal [glucose].

4 marks

3 marks

Other than transport, give two other roles for membrane proteins:

2 marks.

Name _____

Student number _____

32. Your choice:

either show the cycle of steps involved in the action of the Na/K ATPase pump

or show the six step reaction sequence of fatty acid synthase I.

6 marks

Name _____

Student number _____

33. How is pyruvate converted to phosphoenol pyruvate in animal cells?
Show structures of the principle reactants and products, but cofactors such as ATP etc. can simply be named; name the enzymes, and indicate regulators of the first step.

enzyme reaction 1

pyruvate +

enzyme reaction 2

enzyme reaction 3

enzyme reaction 4

phosphoenolpyruvate

Reactions 2 and 3 may seem a bit redundant.

What other event occurs between reaction 2 and reaction 3?

Name _____

Student number _____

34. Show the sequence of events that lead to activation of glycogen breakdown and deactivation of glycogen synthesis.

7 marks

Initial state: fear or stress