

Use a separate answer book for each section.

Section 1

Prof G. Lindsey

86 marks

Please note: describe or explain a reaction or a series of reactions means supplying the names of the enzyme(s) as well as the names and structures of the metabolites concerned.

1. Pentose phosphate pathway:
 - a. Give an approximate value for the $\text{NADP}^+:\text{NADPH}+\text{H}^+$ ratio in the cell. (1)
 - b. How does this differ from the $\text{NAD}^+:\text{NADH}+\text{H}^+$ ratio? (1)
 - c. How does the $\text{NADP}^+:\text{NADPH}+\text{H}^+$ ratio result in the pentose phosphate pathway being demand driven? (4)

2. Glycogen metabolism:
 - a. Describe the reaction catalysed by the enzyme phosphorylase. (3)
 - b. What is the energetic advantage to the cell of breaking glycogen down in this manner rather to form glucose? An approximation of the amount of energy (kJ/mol) involved is required. (3)
 - c. Phosphorylase can exist in 2 different forms, an "a" form and a "b" form. What is the difference between them and how are they inter-converted? (4)
 - d. Phosphorylase can also exist in 2 different conformations, R & T. How is the equilibrium between these two conformations effected by the "a" to "b" conversion? (2)
 - e. Glucose, glucose-6-phosphate and AMP all effect the $\text{R} \leftrightarrow \text{T}$ equilibrium. What effect does each have? (3)

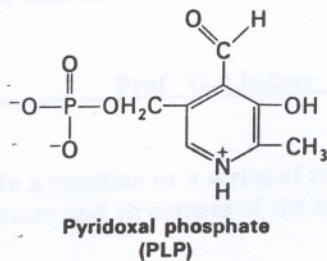
3. AcetylCoA produced in the mitochondrion from glucose is used in the cytoplasm for fatty acid biosynthesis.
 - a. Describe the reactions whereby this is brought about. (5)
 - b. What is the energetic cost to the cell in bringing this about? (1)
 - c. How does this process effect glycolysis and gluconeogenesis and by what mechanism? (3)
 - d. How are reducing equivalents generated as a result of this process for fatty acid biosynthesis? (3)

4. Fatty acid metabolism.
 - a. Describe the mechanism by which fatty acids enter the mitochondrion from the cytoplasm. (6)
 - b. How is propionylCoA produced by β -oxidation of fats when carbon atoms are removed two at a time as acetylCoA? (2)
 - c. Describe how propionylCoA is converted to a TCA cycle intermediate for further catabolism. (7)
 - d. Which vitamin is required for one of these steps? (1)
 - e. How and under what circumstances do the three metabolites that comprise the ketone bodies occur in the cell? (10)

5. Amino acid metabolism.
 - a. Explain why patients suffering from argininosuccinate lyase deficiency are given large quantities of arginine. (8)
 - b. What is the effect of this on the oxaloacetate concentration? (1)
Why should the oxaloacetate concentration be effected when oxaloacetate has no direct involvement with the urea cycle? (3)

6. ADH Practical
 - a. Explain why it is not good practice to give alcoholic beverages to a cold exhausted hiker that you find on the mountain. (6)
 - b. How would set up an assay that requires you to determine the alcohol concentration in the serum of this hiker 1 hour after ingestion of alcohol? A brief description of the methodology, what one would measure, and how this data is processed is required. (9)

Figure for section 1.



Section 2

Prof H H Klump

34 Marks

- 1 A.) How many different topoisomerases are present in a normal bacterial cell and
B.) what is their common function, and in which of their individual functions do they differ? (4)
2. How does supercoiling influence the transcription in prokaryotes? Discuss the following cases
- A. the bacterial chromosome is in a negatively supercoiled state. (2)
B. the bacterial chromosome is in a relaxed state, and (2)
C. the bacterial chromosome is in a positively supercoiled state. (2)
3. Why is positive supercoiling of the circular chromosome advantageous in hyperthermophilic bacteria? (3)
4. Conventional DNA sequences are in the so-called B-DNA conformation.
- A. What are the sequence requirements to allow for a B-DNA to Z-DNA transition? (2)
B. What are the solvent requirements for such a transition to be facilitated? (2)
C. What are the main differences between B-DNA, A-DNA, and Z-DNA structure? (2)
5. A. Describe the most common mechanisms that lead to a point mutation. (3)
B. Are transversion mutations more frequent than transition mutations? (2)
C. Sketch the path that leads to a transition mutation. (2)
6. DNA sequences under certain conditions tend to exhibit an intrinsic curvature.
- A. Sketch such a sequence and list the sequence features that facilitate such a curvature. (2)
B. Describe an experimental set up that can reveal such a curvature. (2)
C. How long should the average sequence be that exhibits a sizeable curvature? (2)
D. Are there any other influences that can contribute to the tendency of a given sequence to curve? (2)