

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF  
SCIENCE IN BIOCHEMISTRY

BIOC 311: BIO MEMBRANES AND CELLULAR SIGNALING

STREAMS: B.Sc (BIOCHEMISTRY) Y4S1

TIME: 2 HOURS

DAY/DATE: FRIDAY 14/12/2018

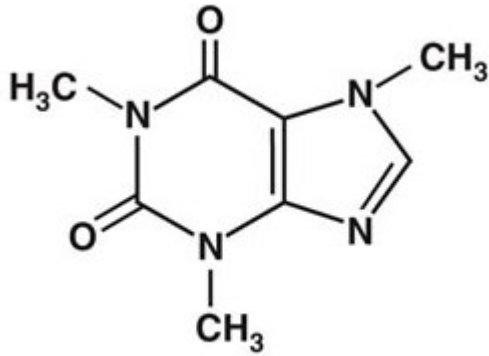
2.30 P.M - 4.30 P.M.

INSTRUCTIONS

- Answer question **ONE (COMPULSORY)** and any other **TWO** questions.
- Sketch diagrams may be used whenever they may help to illustrate your answer.
- Do not write anything on the question paper.
- This is a closed book exam. **No** reference materials are allowed in the examination room.
- There will be **No** use of mobile phones or any other unauthorized materials.
- Write your answers legibly and use your time wisely.

**QUESTION ONE: [30 MARKS] - COMPULSORY**

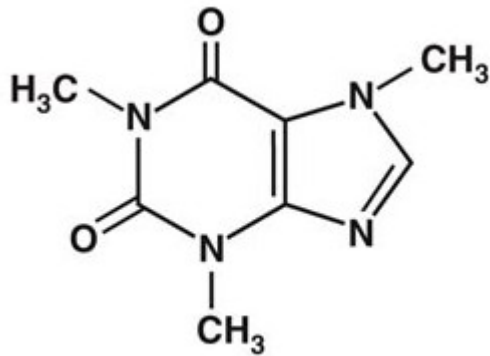
- The drug ouabain inhibits the activity of the  $\text{Na}^+/\text{K}^+$  ATPase. A nerve cell is incubated in ouabain.
  - Make a table in which you predict what would happen to the concentrations of  $\text{Na}^+$  and  $\text{K}^+$  inside the cell, as a result of the action of ouabain. Illustrate also what is expected in a normal cell before treatment with ouabain. [4 Marks]
  - Briefly explain the reasons behind the expectation that you have predicted above. [6 Marks]
- The figure below represents a caffeine molecule. Caffeine acts by binding with a receptor on the cell surface.



a. Explain why caffeine is not able to enter into the cell. [2 Marks]

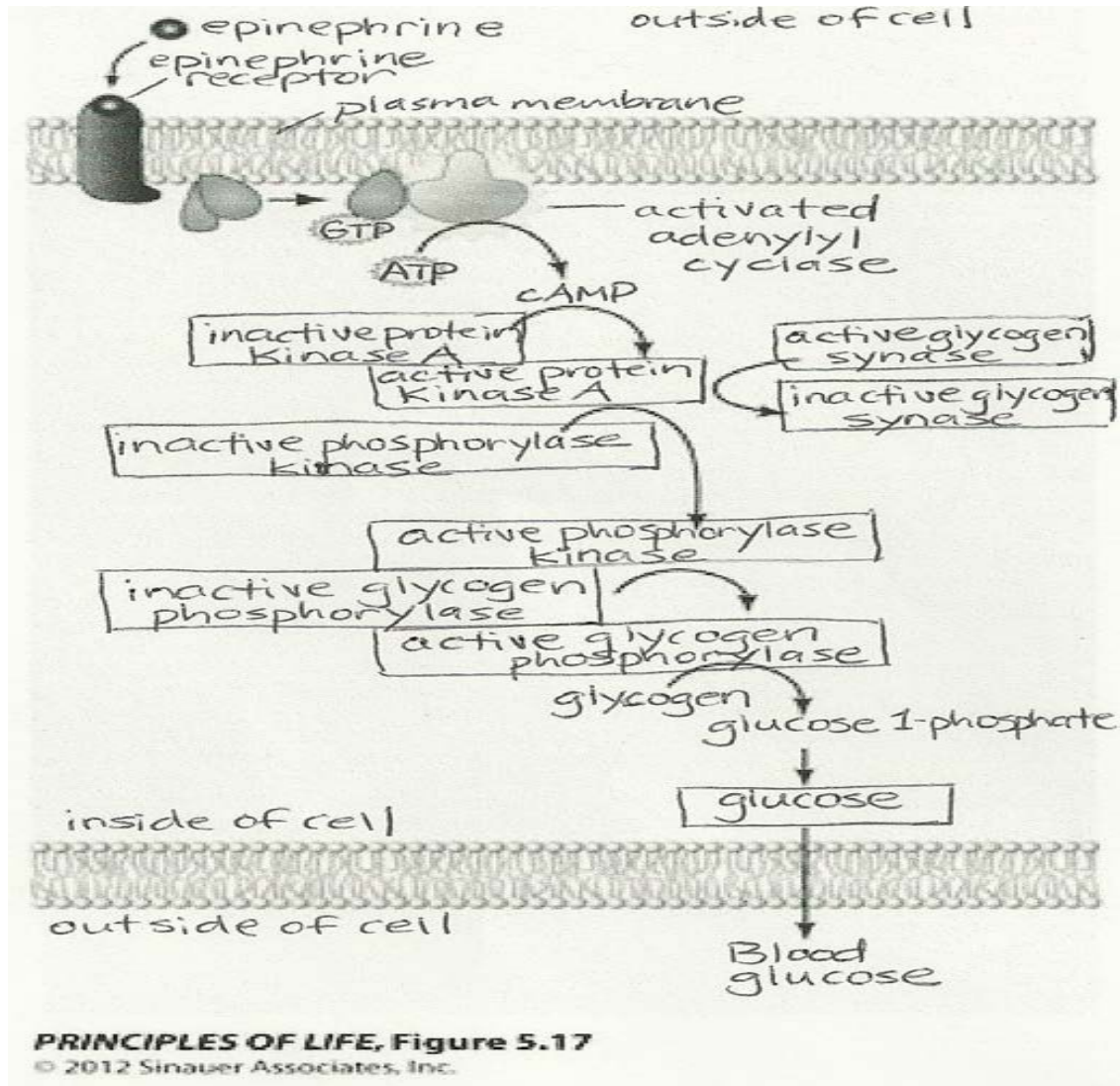
b. Label the parts of the molecule that make it difficult for caffeine to enter the cell

[2 Marks]



iii. If a cell had no proteins in its membrane, will it be able to respond to any environmental stimuli? Explain. [4 Marks]

iv. The diagram below shows an example of a signal cascade. Use the diagram to answer questions below.



- Explains how the signal cascade in the diagram above achieves amplification [6 Marks]
- Describe how the signal cascade above is terminated after the necessary response has been obtained [5 marks]

**QUESTION TWO:[20 MARKS]**

- Different receptor proteins for different signals are found in the cytoplasm or on the membrane of the cell. Give an example of each and discuss the properties of the ligand (small molecule) that activates this receptor. [6 Marks]

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- ii. Organisms and cells must respond to stimuli (signals) from their environment for survival. The signal may be a physical stimulus such as light or heat, or a chemical such as a hormone. In order to respond, the cell must have a specific receptor that becomes modified by the stimulus. Once a receptor in the membrane is activated by the signal, it sets off a series of biochemical changes within the cell. These pathways are sequences of events and chemical reactions that lead to a cell's response to a signal. This ability to respond to the environment is critical to the organisms or cells ability to maintain precision in its homeostatic mechanisms. Describe each of the three major steps in cell signaling. [6 Marks]
- iii. Describe receptor – mediated endocytosis with enough detail to explain whether or not this process meets the criteria for active transport or passive transport [5 Marks]
- iv. Explain the similarities and differences between phagocytosis and pinocytosis [3 Marks]

### QUESTION THREE: [20 MARKS]

- i. Briefly explain the following terms in relation to molecule movement across the cell membrane [6 Marks]
  - (a) Uniport
  - (b) Symport
  - (c) Antiport
- ii. Transport of amino acid through a cell membrane is very important for a better health of individual. Briefly discuss how interference with the transport of amino acids can lead to:-
  - (a) Hartnup disease [4 Marks]
  - (b) Cystinuria [4 Marks]
- iii. Briefly explain how acetylcholine leads to relaxation of the smooth muscles [6 Marks]

**QUESTION FOUR: [20 MARKS]**

- i. Discuss the mode of action of anesthetic used in both local and general anesthesia [4 Marks]
  
  - ii. Discuss how alcohol leads to impaired nervous conduction [3 Marks]
  
  - iii. Discuss the mechanisms of receptor – mediated activation or inhibition of effectors by means of heteromeric G proteins [6 Marks]
  
  - iv. Briefly explain how do the binding of a hormone to the plasma membrane change the activity of cytoplasmic enzymes, with reference to glycogen phosphorylase, an enzyme involved in glycogen metabolism. [3 Marks]
  
  - v. Briefly discuss the role of Nitric oxide as an intercellular messenger in cellular communication [4 Marks]
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