

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

SEMESTER 2 ASSESSMENT, 2005

**521-304 HORMONE & NEUROTRANSMITTER BIOCHEMISTRY**

**EXAM DURATION:** THREE (3) Hours

**READING TIME:** Fifteen (15) Minutes

**THIS PAPER HAS 3 PAGES**

**Instructions to Students:**

*This exam paper accounts for 80% of the total marks for the subject.*

Marks are allocated in proportion to the time advised for each question or section.

This paper consists of **TWO** (2) sections, A and B.

**SECTION A**

You should attempt **THREE** (3) questions in Section A.

Suggested time – 40 minutes for each question.

All questions in this Section are of equal value.

**SECTION B**

You should attempt **FOUR** (4) questions in Section B.

Suggested time – 15 minutes for each question.

All questions in this Section are of equal value.

Use a **SEPARATE** examination book for **EACH** question.

**Authorized Materials:**

No specific materials are authorized.

**Instructions to Invigilators:**

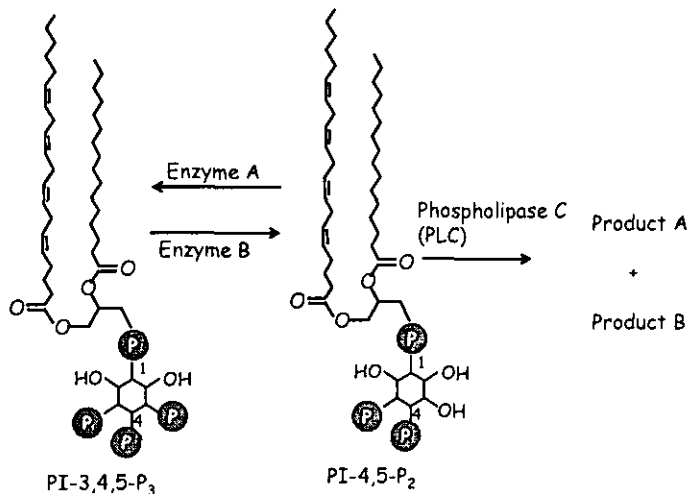
Students need **SEVEN** (7) 7-page examination script books.

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**SECTION A** (Attempt **THREE (3)** of the following four (4) questions  
(suggested time 40 minutes per question)  
Use a **SEPARATE** script book for each question

**Question 1**

Fig. 1 depicts the reactions by which phosphatidylinositol-4,5-bisphosphate (PI-4,5-P<sub>2</sub>) is converted to the intracellular second messengers: phosphatidylinositol-3,4,5-trisphosphate and products A & B.



**Figure 1**

- Name Enzyme A, Enzyme B, Product A and Product B. (8 minutes)
- Use a schematic diagram, describe the signalling pathway by which EGF stimulation of EGF-receptor in fibroblasts leads to activation of Enzyme A and phospholipase C<sub>γ</sub> (PLC<sub>γ</sub>). (16minutes)
- What are the functions of Product A and Product B? (16 minutes)

**Question 2**

With the help of a schematic diagram, discuss how nitric oxide, produced in the endothelial cells lining the lumen of a blood capillary, regulates the activity of cGMP-dependent protein kinase in the adjacent smooth muscle cells.

**Question 3**

It has been estimated that amplification of signal resulting from the transduction of a single photon of light activating retinal rod cells in the visual system is of the order of 10<sup>7</sup> fold. Describe the molecular and cellular events involved in this process, including the mechanisms operating to reset the system after a flash of light.

**Question 4**

The diversity of peptide hormones in the nervous and endocrine systems results from alternative mRNA splicing, post-translational processing and tissue-specific processing. Describe with examples how these processes lead to the generation of families of biologically active hormones and neurotransmitters.

**SECTION B (Attempt FOUR (4) of the following seven (7) questions)**  
**(suggested time 15 minutes per question)**  
**Use a SEPARATE script book for each question**

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**Question 5**

With the help of a schematic diagram, describe how CHRONIC cocaine exposure alters the phosphorylation status of DARPP-32 in neurons of the nucleus accumbens. Your answer should include the signalling pathways in neurons that are stimulated upon chronic cocaine exposure.

**Question 6**

Chronic myelogenous leukaemia (CML) is caused by the overexpression of the constitutively active BCR-Abl tyrosine kinase in lymphoid cells. Paradoxically, STI-571, which binds exclusively to the inactive conformation of Abl tyrosine kinase, can suppress the growth of the cancer cells by inhibiting BCR-Abl tyrosine kinase. With the help of a schematic diagram, discuss how STI-571 inhibits BCR-Abl.

**Question 7**

The synthesis and secretion of thyroid hormones are closely linked to iodine metabolism. Describe how iodide derived from the diet contributes to thyroid hormone metabolism. Include in your answer the key reactions involved and their cellular locations, the mechanism for the transport of free iodide into follicular cells of the thyroid gland and how thyroid hormones are transported to target tissues.

**Question 8**

Synthesis of the hormones adrenaline and noradrenaline is subject to a number of different regulatory mechanisms. Outline the different control mechanisms that operate to regulate catecholamine biosynthesis following catecholamine release.

**Question 9**

The M2-membrane-spanning region of ligand-gated ion channels is important in controlling ion movement. Describe the role of hydrophobic and charged residues in this process. What features of these channels contribute to the observed differences in ion selectivity between acetylcholine- and GABA<sub>A</sub>-gated receptors?

**Question 10**

Axonal transport is an important mechanism for intracellular communication in neurons. Describe the main molecular features of axonal transport and outline its functions in neurosecretory neurons of the hypothalamo-neurohypophysial system.

**Question 11**

Parkinson's disease is a neurodegenerative disorder whose symptoms can be lessened by the use of L-DOPA. Describe the proposed role of synuclein in the degeneration process and the biochemical and pharmacological rationale for treatment of Parkinson's disease with L-DOPA and pharmacological agents.

**END OF EXAM**