

**UNIVERSITY OF SWAZILAND**  
**Faculty of Health Sciences**

**DEGREE IN ENVIRONMENTAL HEALTH**  
**SUPPLEMENTARY EXAMINATION PAPER 2005**

**TITLE OF PAPER** : INTRODUCTION TO ENVIRONMENTAL TOXICOLOGY

**COURSE CODE** : EHS 524

**DURATION** : 3 HOURS

**MARKS** : 100

**INSTRUCTIONS** :

- : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
- : ANSWER ANY FOUR QUESTION
- : EACH QUESTION CARRIES 25 MARKS.
- : WRITE NEATLY & CLEARLY
- : NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM.
- : BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

**DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.**

Question 1.

- a) Explain the "first pass effect" and why this form of elimination results in a low level of expression of toxicity from a xenobiotic (5 marks)
- b) What unique characteristics of the central nervous system that makes it vulnerable to xenobiotics? (5 marks)
- c) Complete the following table regarding the major biotransformation reactions;

PHASE I	PHASE 2
1.	1.
2.	2.
3.	3
4.	4
5.	5

(10 marks)

Question 2.

- a) Describe the difference between necrosis and apoptosis in cell death. Relate to the level of toxic injury. (5 marks)
- b) What does Blood Brain Barrier (BBB) mean? (5 marks)
- c) State the reasons why studying toxic responses of the reproductive system in humans is sometimes difficult (5 marks)
- d) What is the difference between a toxin and a toxicant? (5 marks)

(Total = 20 marks)

Question 3.

- a) Explain what is meant by **DISPOSITION** of a xenobiotic? (4 marks)
- b) In the fourth stage of the mechanism of toxicity there is a decision that the cell has to make about repair or dysrepair. What are the various levels of repair in the organism that could take place after damage or toxicity occurs? (8 marks)

- c) What are the three basic assumptions of a dose-response curve or measurement?  
(3 marks)
- d) What is the difference between the therapeutic index and the margin of safety?  
(5 marks)

#### Question 4

**MULTIPLE CHOICE:** Select the best letter that completes all statements.  
(Each question carries two (2) marks)

- 1) The unique vulnerability of the central nervous system, especially the brain, to toxicants depends on :
- A) The high oxygen and glucose demand.
  - B) The high lipid content of the brain that retains the lipophilic solvents.
  - C) Many and varied transport processes of the blood-brain barrier.
  - D) The lack of mitosis or replacement of cells in the neuronal tissue
  - E) All of the above.
- 2) Factors involved in the delivery of the toxicant include;
- A) The mode of exposure of the toxicant
  - B) The biotransformation of the toxicant
  - C) The distribution of the toxicant in the body
  - D) Elimination of the toxicant
  - E) The absorption of the toxicant
  - F) All of the above
  - G) Items A, B, C, and D of the above
- 3) All of the following are true of the peripheral neurotoxicity except;
- A) Involves the nerves in the arms and legs
  - B) Is commonly associated with organic solvents
  - C) Is often characterized by the "dying back" syndrome
  - D) Is never associated with other expressions of neuronal toxicity such as confusion or behavioural changes
  - E) Often cross-linking of proteins or specific neuronal cell structures are involved in the toxicity
- 4) Types of ultimate toxicants are;
- A) Parent compounds never metabolised
  - B) Bioactivated metabolites of chemical toxicants
  - C) Reactive oxygen species produced by toxicant
  - D) Endogenous compounds activated by metabolites of toxicants
  - E) All of the above
  - F) Items A, B, and C of the above

- 5) Under the term "pulmonary toxins" which statement is **not** true?
- A) Pulmonary toxins are usually divided into three groups - mucosal toxins, bronchoconstrictors, and chemicals causing fibrosis
  - B) Asbestos, beryllium, and coal dust are usually classified as mucosal toxins
  - C) Ammonia, chlorine, hydrocarbons, and oxides of nitrogen are usually classified as under mucosal toxins which affect the lining of the lung
  - D) Sensitising agents such as toluene diisocyanate used in foam packaging and nonsensitizing irritants such as smoke and perfume are called bronchoconstrictors because they cause hyper-reactivity of the small airway structure or bronchioles.
  - E) Chemicals causing fibrosis are often small particles that get into the interstitial tissue of the lung and body may react to their presence of forming fibrotic lesions
- 6) Reasons that the kidney is particularly susceptible to toxic damage include;
- A) Its concentration function
  - B) A large fraction of cardiac output goes to the kidney
  - C) Metabolic activation of xenobiotics
  - D) Renal stress caused by extra renal effects such as decrease in blood pressure or blood volume
  - E) All of the above
- 7) There are many expressions dealing with various types of doses producing an effect on an organism. Which of the following statements below are **CORRECTLY** defined?
- A) The effective dose is the dose at which the desired therapeutic or effect is achieved.
  - B) The toxic dose is the dose at which designated undesirable adverse health effect is observed.
  - C) The therapeutic index is defined as  $LD_{50}$  divided by  $ED_{50}$ .
  - D) The margin of safety for a drug is defined as  $ED_{99}$  divided by  $LD_1$ .
  - E) Effective dose 99 is the dose at which 99% of the population is achieving the desired effect.
  - F) All statements are correct
  - G) Only statements A, B, C, and E are correct
  - H) Only statements A, B, C, and D are correct
- 8) Active transport is very important in the process of absorption of xenobiotics for closed systems. Which of the following statements are **CORRECT** for active transport?
- A) Active transport systems can be saturated and thus after the system is saturated high blood levels of the transported species can occur.
  - B) Active transport systems are specific for particular kinds of molecules
  - C) Active transport occurs against a concentration gradient
  - D) Active transport requires the expenditure of energy.
  - E) Toxicants can gain entry into closed barrier systems such as the blood-brain barrier by mimicking or being similar to the normal molecule carried by the system.

- F) All of the above are correct  
 G) Statements A, B, C, and D are correct.  
 H) Statements B, C, and D are correct
- 9) Choose the statements that are associated with the science of toxicology.
- A) It is the dose that determines the toxicity.
  - B) The dose-response curves are fundamental to the relationship of cause and effect in toxicology
  - C) Toxicology is the science dealing with a chemical (toxicant) or toxin producing an adverse health effect.
  - D) Toxicology is the science dealing with the imbalance of normal cellular function caused by a toxicant or toxin
  - E) In toxicology, safety is defined as 1 divided by the risk
  - F) All of the are correct
  - G) Items A, B, C, and D are correct
  - H) Items A, C, D, and E are correct
- 10) There are many routes of absorption of a toxicant into the body. Which of the following represent these routes and facts associated with absorption.
- A) The skin absorption increased by the use of organic solvents and water.
  - B) The lung with the size of a particle determining where it settles in the respiratory tract
  - C) The gastrointestinal tract with absorption greatly enhanced due to the increased surface area of the gut dependent on the villi and crypts of the intestine and also because of special transport in the intestine.
  - D) Intravenous injection of xenobiotic under the skin
  - E) Intraperitoneal by injection into the mesentery are of the intestines.
  - F) All of the above statements are true for absorption of toxicants
  - G) Item B, C, D, and E are correct
  - H) Items A, B, C, and E are correct

**(2 marks each. Total = 20 marks)**

### Question 5

- A. Organophosphates are used as pesticides in gardens and agriculture and in chemical warfare;
- a. What is the basic structure of organophosphates and the differences in structure and action between the agent used in chemical warfare versus a common pesticide? (10 marks)
  - b. What is the mechanism of action of organophosphates that makes them toxic (5 marks)

B.

The Stockholm Convention on Persistent Organic Pollutants (POPs) has targeted twelve (12) POPs for elimination and eight of these are pesticides; Name only five (5) of these pesticides.

(5 marks).