UNIVERSITY
OF
JOHANNESBURG

PROGRAM: **NATIONAL DIPLOMA *ENVIRONMENTAL HEALTH***

SUBJECT: **ENVIRONMENTAL POLLUTION III**

CODE: **ENP 32-1**

DATE: **11 NOVEMBER 2017**

PAGES: **7**

DURATION: **3 Hours**

TOTAL EXAM MARKS: **150 Marks**

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INSTRUCTIONS TO STUDENTS

1. Answer all questions

2. Carefully read the questions. You will be penalized if your answers are not properly structured and numbered

3. ENP 32-1 is a practical module and each main heading must be supported by a practical example where appropriate

4. Use a calculator where you find the need

5. Plain numbers/values i.e., 1 or 5 does not send any message; please provide units and justifications as outputs for every value as the case applies

NOTE: You are allowed to flexibly respond and or react to the questions based on the knowledge and understanding you have gathered on environmental pollution from site visits and in the classroom as covered in this module.

Question 1 [25 Marks]

In present times, air pollution is no longer considered a new phenomenon and it is has been established that not all pollutants found in the air is born of human activities. You have also learnt that natural pollutants are sporadic and are usually influenced by geographical disperse. In as much as we cannot control the devastating effects of volcanoes, we can nonetheless, do something to reduce emissions generated by human activities. As environmental specialists, attempt the following questions:

a) Identify 3 major human activities leading to the release of air pollutants and list 3 examples of processes under each activity. [5]

b) Identify the basic physical forms of air pollution, briefly describing each and listing 2 examples of for each physical form. [5]

c) Identify the categories of air pollution emissions, briefly describing each and listing 3 examples/ sources for each category. [5]

d) It is true that in South Africa the discovery of stone bearing traces of gold in 1886 by unemployed miners created air quality problems. Mention 3 ways through which this resource discovery contributed to air pollution in South Africa. [5]

e) With your knowledge on environmental health economics of air pollution, motivate on whether or not poor people are more exposed to air pollution than the rich. [5]

Question 2 [25 Marks]

The global world in present times gathers and discusses air quality challenges as a result of fuel burning. Coal is the largest single source of pollution at a global scale however, it is true that regional and local scale source effects cumulatively contribute to heightened pollution levels influenced by pollutants dispersal processes. As environmental scientists, provide constructive responses to the following questions:

a) Why is coal such a sought after commodity domestically and globally? [3]

b) Bearing in mind the 3 scales of pollution, highlight some of the impacts and level of occurrences you know. [5]

c) In deep thoughts about the source of pollution from the burning of coal in various areas in South Africa, briefly explain in what way(s) *acid* can be deposited the impact it has on environmental and human health. [5]

d) Still in thoughts about the source of pollution from the burning of coal in various areas in South Africa, briefly explain the way(s) in which *eutrophication* can be caused and its effects ecology. [5]

e) Area sources are generally small or mushroom contributors to ambient air pollution, reflect to one informal settlement and identify 3 activities linked to increased emissions. Then briefly motivate as to whether or not the identified sources pose a threat to human and environment health collectively per annum. Finally, how can this problem of area sources be dealt with? [7]

Question 3 [25 Marks]

Councilor Mashaba the current Mayor of the City of Johannesburg Metropolitan committed to improve air quality in informal settlements. The current area sources of pollution include the use of coal, wood and kerosene as basic energy resources. Nonetheless, the Mayor has called your expertise on unraveling certain urgent issues on major gaseous pollutants including; sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen oxides (NO_x) as well as ozone (O_3). The primary source of these gases is the combustion of fossil fuels in power plants, various industrial processes, and motor vehicles and equipment. Each of these pollutants, in their gaseous form, can cause harm to human health and the environment. They are also essential ingredients in chemical and physical transformations which can result in further damages. Now, the Mayor seeks answers to the following questions:

a) What is ozone (O_3)?   [3]
b) The Mayor has gathered that there is a thing as "good" and "bad" ozone (O_3) and has become confused and needs clarification. How do you make him understand?   [5]
c) The Mayor also wants to understand what ground level ozone is and where it is from. How do you attend to his concern?   [4]
d) He also learnt that there can be too much ozone and wants to know the effects of that on environmental and human health. What will you tell him?   [5]
e) Based on the effects of too much ozone, explain to the Mayor what bio-indicators or phytotoxic indicators are.   [8]

Question 4 [25 Marks]

An emergency alarm has been triggered on the Doornfontein Campus for desperate reasons of particulate matter, which appears a mixture of solid and liquid droplets released from combustion and looks to be a type of solid in the air in a form of dust, smoke and vapor. This has remained suspended for extended periods of time and the vice-Chancellor and Principal of the University of Johannesburg sees this development as a hazard due to the fine particles present in the air. He has then called on you to

address certain questions for fear of what risk this issue might hold with regards to the occupants of the Doornfontein Campus premises. As a specialist in environmental pollution, it did not take long for you to establish that the particulate matter is DUST. Based on available information, supply answers to the following questions:

a) Define the following terms

(i) Hazard   [2]
(ii) Risk   [2]
(iii) Dust   [2]
(iv) Vapour   [2]

b) Why do you think the vice-Chancellor is concerned about the fine particles present in the air?   [4]

c) List the major factors affecting the absorption and distribution of a harmful substance when entered into the body.   [4]

d) In consultation with a toxicologist to pin down the effects of other possible toxins, you monitored the response to the toxicant on test samples. The graph below gives the dose-response relationship of two identified toxicants; A and B on a population sample reference.
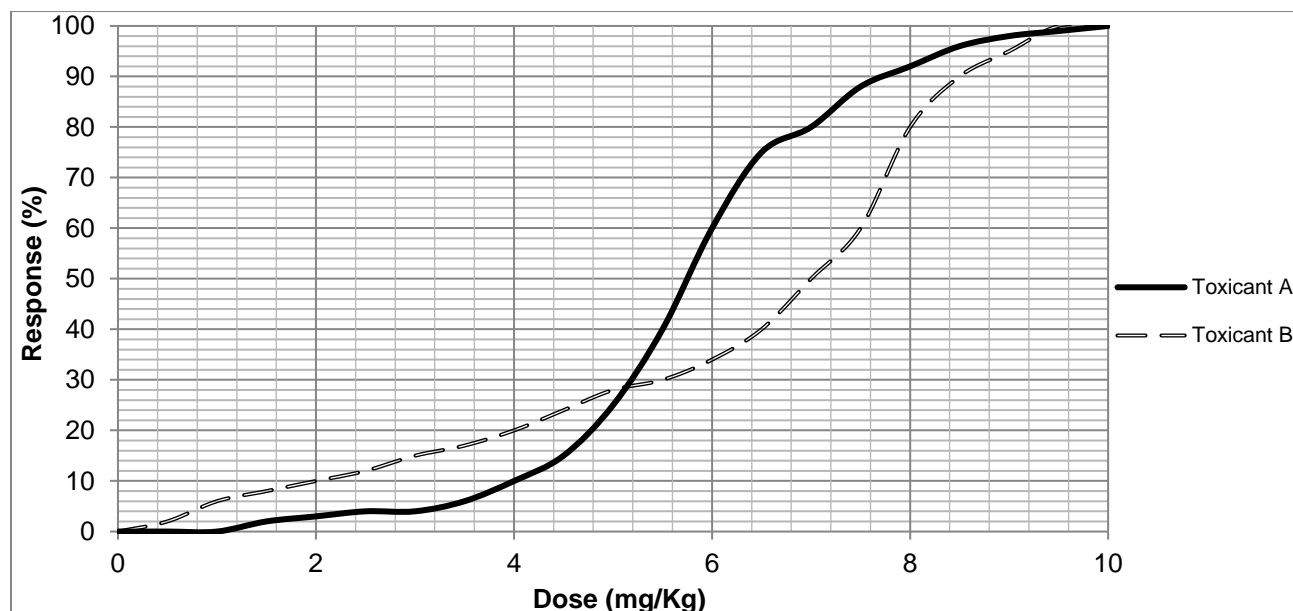
(i)   Define LD$_{50}$ [2]
(ii)   Estimate the threshold value for toxicant A   [2]
(iii) Determine the LD$_{50}$ of toxicant A and B   [2]

(iv)   Which substance is more toxic at a dosage of 4.5 mg/Kg and why?   [3]

Question 5 [25 Marks]

a) Bearing in mind the scenario in Question 4; as part of further investigative process you collected air sample from a start time of 08:00 to an end time of 17:00 and it was established that the major content on the dust is silica. All the information gathered during the process was recorded in the table below. Showing all necessary workings, provide answers by calculating the following:

Pump status	Time	Flow Rate(L/min)	Filter Mass(g)	Silica Content (µg)
ON	08:30	1.7	0.003	-
OFF	16:45	1.6	0.467	440

CALCULATE:

(i)   The mass of total dust on the filter   [2]
(ii)   The sample time over which the dust was collected   [2]
(iii) The average flow rate of the pump   [2]
(iv) The volume of air sampled   [2]
(v)   The silica content on the dust   [2]
(vi) The silica content as a percentage of the total dust sampled   [2]
(vii) The permissible exposure limit (PEL) for silica   [3]
(viii) Also indicate/ motivate as to whether or not occupants of the Doornfontein Campus premises are over-exposed to dust based on your findings.   [2]

b) The vice-Chancellor has requested a discussion with you on the characteristics of silica. What will you tell him?   [3]

c) The vice-Chancellor is also interested in understanding why silica is essential to many industries, although it has adverse side effects on human health which also forms part of his concerns based on the pollution case at hand.   [5]

Question 6 [25 Marks]

The main reason for air pollution control programs is to protect public health based on the effects of pollution on people and the environment. It is also known that the effects of air pollution are chronic and not immediately obvious hence, proper monitoring systems are usually required for an efficient pollution control program which includes air

quality measurements. As an air quality specialist and with reference to the conditions in Question 4, respond to the following questions:

a) Measurements of air quality generally fall into three classes. List the respective classes and briefly explain each. [3]

b) Briefly discuss what air sampling techniques you would apply to the Doornfontein pollution scenario on a short to long term pollution control program? [3]

c) When obtaining a sample for air pollution analysis, what factors should you consider? Briefly discuss them. [3]

d) What air sampling systems will you consider best for the Doornfontein pollution scenario? [2]

e) What air sampling procedures will you best recommend? [2]

f) List the general requirements for a site selection. [3]

g) The type of equipment used for air quality testings and analysis may be determined by many factors. List some of the factors that dictate the choice of sampling equipment. [3]

h) Two types of calibration procedures are commonly used on air monitoring equipment. List and briefly describe each. [2]

i) When it comes to air quality monitoring, data handling ranges from the simplest manual methods to very sophisticated electronic devices. List the two data handling methods currently available briefly describing each. [2]

j) In source sampling, mention some techniques through which particulate matter can be collected. [2]

TOTAL = 150 Marks