



PROGRAM: NATIONAL DIPLOMA *ENVIRONMENTAL HEALTH*

SUBJECT: ENVIRONMENTAL POLLUTION III

CODE: ENP 32-1

DATE: SUPPLEMENTARY EXAM JANUARY 2018

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]

An emergency alarm has been triggered on the Soweto 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 Soweto 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:

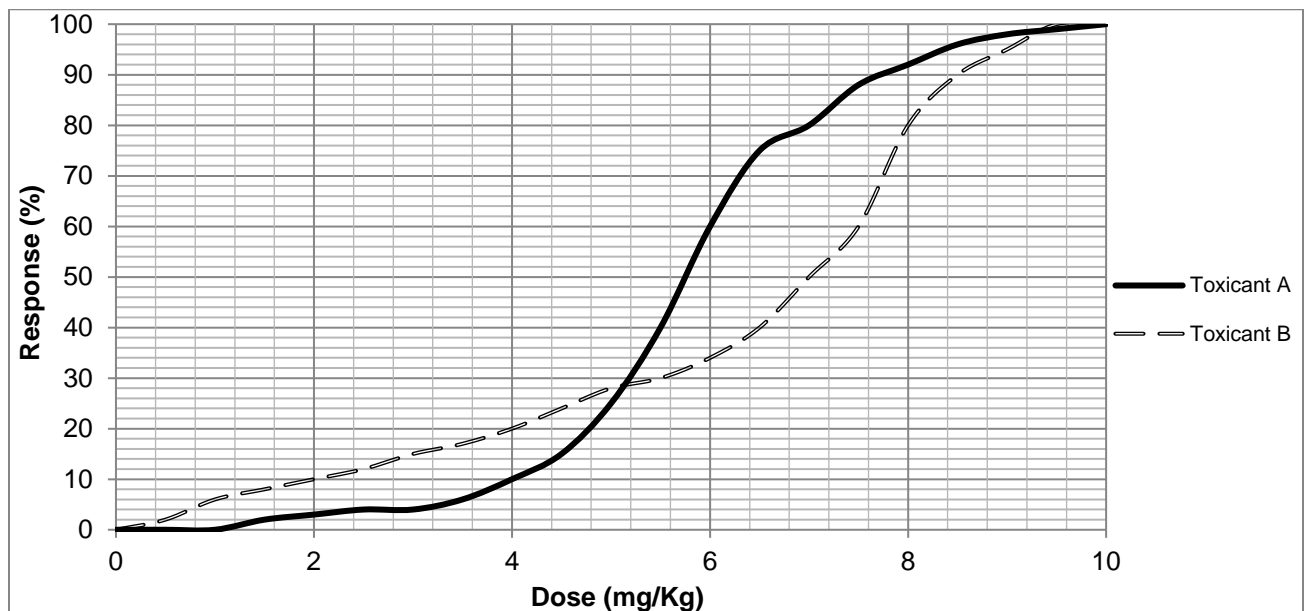
a) Define the following terms

- (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 LD₅₀ [2]
- (ii) Estimate the threshold value for toxicant A [2]
- (iii) Determine the LD₅₀ of toxicant A and B [2]
- (iv) Which substance is more toxic at a dosage of 4.5 mg/Kg and why? [3]

Question 2 [25 Marks]

a) Bearing in mind the scenario in Question 1; as part of a 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 as shown. 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 Soweto 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 3 [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 1, 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 Soweto 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 Soweto 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]

Question 4 [25 Marks]

In present times, air pollution is no longer considered a new phenomenon and it 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 5 [25 Marks]

Currently the global community meets at various levels and with varied interest: air quality, business, and environmental conservation and policy agreements in addressing issues around energy disparities, inefficiency and air pollution. However, the focus in this case is on energy efficiency, cleaner production and better combustion efficiency. As an environmentalist keeping abreast with the global discuss, explain the following concepts or terminologies often applied to air quality:

- a) Combustion [3]
- b) Complete and Incomplete combustion [3]
- c) According to the new South African National Standards the CO:CO₂ ratio for paraffin must be below 2%. When it is high, what does it imply? [3]
- d) For combustion to occur three things must be present. What are they? [3]
- e) It is true that fuel to be burned must be analysed to determine its suitability amongst other reasons. Mention the two common methods of analysis. [2]
- f) In the case of a fuel/ biomass to be burned, what are the two common chemical analysis of interest? Briefly mention the purposes of each analysis. [5]
- g) In relation to physical analysis, briefly explain ash fusion and state why it is important. [3]

- h) It is well known that ash consists of many incombustible substances and minerals. Mention some of the minerals and state the effect they have on ash fusion in relation to combustion efficiency. [3]

Question 6 [25 Marks]

In meteorology weather and climate play a crucial role especially in air pollution dispersion. Bearing this in mind, supply answers to the following questions:

- a) Discriminate between weather and climate. [3]
- b) List and explain the meteorological factors influencing air pollution dispersion. [7]
- c) Briefly explain the concept of atmospheric stability in air pollution. [3]
- d) Explain how temperature and pressure affect density. [3]
- e) What is Lapse rate? [2]
- f) It is true that two types of lapse rate have been studied and documented. Mention and briefly explain each. [3]
- g) Two types of adiabatic lapse rate have also been studied and documented. Mention and briefly differentiate between them. [4]

TOTAL = 150 MARKS