BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF ENVIRONMENTAL SCIENCE

BSc. (Hons) DEGREE IN SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT

ESM 411 (1)

BSc PART IV EXAMINATION
Occupational Hygiene & Toxicology

2 HOURS

INSTRUCTIONS
Answer question **one** from SECTION A any **two** from SECTION B.

JUN 2023

SECTION A (compulsory)

1. (a) Describe the toxicokinetics of a toxic agent in the body of an exposed worker. **[10 Marks]**

   (b) Explain the following:
      (i)   LD50, 35mg/kg, oral, rat **[3 Marks]**
      (ii) $WBGT = 0.7T_w + 0.3T_g$ **[3 Marks]**

   (c) Outline five preliminary inspections and observations that may be undertaken before assessment of the hazard. **[10 Marks]**

   (d) Explain the difference between:
      (i)   standard and guideline **[2 Marks]**
      (ii) specification standard and performance standard **[2 Marks]**

SECTION B

2. (a) (i) Explain the term acclimatisation with reference to heat stress. **[1 Mark]**
       (ii) Describe methods by which the human body temperature exchanges heat with its environment. **[4 Marks]**

   (b) Describe the components of an organisational heat stress management programme. **[10 Marks]**

   (c) (i) What is the general purpose of an occupational exposure limit? **[2 Marks]**
       (ii) Describe the three types of occupational exposure limits. **[3 Marks]**

3. (a) (i)   What are direct-reading analytical instruments? **[1 Mark]**
       (ii) Suggest a difference between passive and active air samplers? **[1 Mark]**
       (iii) Suggest three advantages direct-reading instruments have over non-direct-reading instruments. **[3 Marks]**

   (b) Describe any five features of direct-reading industrial hygiene air quality monitoring instruments. **[5 Marks]**

   (c) Identify three environmental conditions which affect the accuracy and usefulness of direct-reading instruments. **[3 Marks]**

   (d) How many hours are needed to sample 24 L of air at a flow rate of 2.5 L/min? **[2 Marks]**

   (e) Describe the principle of operation of a spectrophotometer. **[5 Marks]**

4. (a) (i)   Explain radioactivity. [1 Mark]
   (ii)   What types of human cells tend to be the most sensitive to biological damage from ionising radiation? [1 Mark]
   (iii)   Why are children more sensitive to the harmful effects of ionising radiation? [1 Mark]
   (iv)   Why is an alpha-particle capable of doing great biological damage to living tissue? [1 Mark]
   (v)   Which body organ is commonly exposed to and especially sensitive to alpha-particles? [1 Mark]
   (b) Suggest five reasons that justify the consideration of engineering controls as the most efficient hazard prevention approach. [5 Marks]
   (c) Justify the inclusion of quality assurance in occupational hygiene. [10 Marks]

5. (a) (i)   For a gas, which pair of variables are inversely proportional to each other (if all other conditions remain constant)? [2 Marks]
   (ii)   What is the density of ammonia gas at 2.00 atm pressure and Temperature of 25°C? [3 Marks]
   (b) Potassium bicarbonate ($KHCO_3$) decomposes to give gaseous products. If decomposition occurs at 520°C and 580 torr,
   (i)   Write down the chemical equation for the decomposition of potassium bicarbonate. [2 Marks]
   (ii)   Determine the volume of gas (in L) that would result from the decomposition of 33g of potassium bicarbonate. [3 Marks]

   (c) (i)   If sound pressure is 0.02 Pa, what will be the sound pressure level? [2 Marks]
   (ii)   Suppose two machines produce equal sound pressure levels of 80 dB, what will be the total sound pressure level recorded? [2 Marks]
   (iii)   Comment on your answer. [1 Mark]

   (d) (i)   Urauim-235 is the isotope used in many nuclear reactors. Explain How the fission of Uranium-235 can lead to a chain reaction. [3 Marks]
   (ii)   What happens inside the reactor if neutrons speeds are not controlled? [2 Marks]

END OF PAPER