

# **UNIVERSITY OF SWAZILAND**

## **FACULTY OF HEALTH SCIENCES**

### **MAIN EXAMINATION PAPER – DECEMBER, 2014**

**TITLE OF PAPER** : **RODENTS AND VECTOR CONTROL**  
**COURSE CODE** : **EHM200**  
**TIME** : **2 HOURS**  
**MARKS** : **100**

**INSTRUCTIONS** : **ANSWER QUESTION 1 AND ANY THREE QUESTIONS**  
: **EACH QUESTION CARRIES 25 MARKS**  
: **NO FORM OF PAPER SHOULD BE BROUGHT INTO  
NOR TAKEN OUT OF THE EXAMINATION ROOM**  
: **BEGIN THE ANSWER TO EACH QUESTION ON A  
SEPARATE SHEET OF PAPER**  
: **CALCULATORS MAY BE USED BUT THEY MUST BE  
THE SILENT TYPE**  
: **ALL CALCULATIONS/WORK-OUT DETAILS SHOULD BE  
SUBMITTED WITH YOUR ANSWER SH**

**This question paper consists of 7 printed pages including this one**

**QUESTION 1****a. MULTIPLE CHOICE**

Indicate your response to items in this question by writing down the letter corresponding to your chosen answer among the possible options provided. (20)

- i. Which one of the following statements **DOES NOT** apply to members of the Phylum Arthropoda?
- A. They possess jointed appendages or limbs
  - B. Their internal organs are protected by an exoskeleton
  - C. They all possess antennae on the head for sensory purposes
  - D. Their bodies consist of head, thorax and abdomen
  - E. Their bodies are dorso-ventrally flattened
- ii. The part of an insect responsible for secretion of digestive enzymes is the:
- A. Malpighian tubules
  - B. gastric caeca
  - C. proventriculus or crop
  - D. gizzard
  - E. ileum
- iii. Some insects mate once in their lifetime and the spermatozoa are kept in a special organ in the female to fertilize eggs as and when they are produced. The structure in which sperms are kept in the female insect is known as a(n):
- A. accessory gland
  - B. ovary
  - C. spermatozoon
  - D. spermatheca
  - E. seminal vesicle
- iv. The reproductive process in some arthropods where eggs with well developed shells hatch within the body of the female and young ones are then produced is referred to as:
- A. oviparous
  - B. larviparous
  - C. ovoviviparous
  - D. parthenogenesis
  - E. larvoviviparous

- v. One of the ticks below is a vector for *Rickettsia rickettsia* which causes tick-borne typhus or Rocky Mountain Spotted Fever (RMSF), an illness that develops first on the wrists, hands, ankles and feet, spreading rapidly centrally to cover most of the body including palms, soles and face of infected human hosts. Which one of the ticks is involved?
- A. *Ixodes pilosus*
  - B. *Boophilus annulatus*
  - C. *Otobius megnini*
  - D. *Argas persicus*
  - E. *Dermacentor andersoni*

- vi. An entomologist recovers the wings below from two flies during some studies he undertakes in Central Africa.



Wing 1

Wing 2

The flies from which the wings were recovered are likely to be:

- A. *Muscadomestica* and *Drosophila melanogaster*, respectively
  - B. *Glossinamorsitans* and *Muscadomestica*, respectively
  - C. *Simulium damnosum* and *Glossinapalpalis*, respectively
  - D. *Muscadomestica* and *Glossinamorsitans*, respectively
  - E. Both wings are from different *Glossina* species.
- vii. A householder at a peri-urban homestead wants to buy a storage refuse bin that will prevent entry of rodents. Which of the characteristics below would give him the best refuse bin?
- A. Water-tight, easy closing plastic material, single-use.
  - B. One with 2 cm diameter holes at the bottom to allow draining, black-heavy plastic material, two handles.
  - C. Heat resistant, tight-fitting lid, heavy construction and recessed bottom.
  - D. Black-coloured plastic, water-tight, disposable.
  - E. Both B and C.
- viii. Which one of the factors below DOES NOT influence the application and efficiency of an insecticide during indoor residual spraying?
- A. The type of water used for mixing i.e. stream, pond, rain, etc.
  - B. Toxicity of the insecticide
  - C. The concentration of the insecticide in the formulation
  - D. The velocity of the wind on the day
  - E. The efficacy of the spraying personnel

- ix. A sprayer wants to spray wood, brick, plaster, cement or dried mud surfaces so that the insecticide which later evaporates over an insect that alights and walks on the surface comes to its contact leading to death of the insect. The most likely formulation the sprayer will choose is a(n):
- A. water-dispersible powder
  - B. pellet
  - C. granules
  - D. emulsifiable concentrate
  - E. insecticidal surface coatings
- x. A woman is cooking bovine offals inside her kitchen. After a few minutes of boiling, she notices several flies inside attracted by the smell of the cooking offals. Which of the insecticides below would the woman most likely choose to use to remove the nuisance from the flies?
- A. diazinon
  - B. malathion
  - C. d'phethrin + piperonylbutoxide
  - D. bendiocarb
  - E. propoxur
- b. Write **T** (true) or **F** (false) for each of the statements below: (5)
- i. The cockroach possess of mouthparts that are said to be sponging types.
  - ii. The empodium is a hairlike form of the arolium found in flies.
  - iii. Some insects have coxal glands that open on the coxae of the legs and are used to remove nitrogenous wastes from the body.
  - iv. Mosquitoes undergo indirect metamorphosis, also called holometabolous development in their life cycle
  - v. An insect that has adequately adapted to leaping usually has long, slender legs.

## QUESTION 2

- a. Houseflies are important dipteran vectors of many diseases of humans and their populations should be closely monitored and kept low.
- i. Are houseflies biological or mechanical vectors of human disease? Explain. (3)
  - ii. What characteristics make houseflies Dipteran insects? (2)
- b. Knowledge of housefly reproduction is important in order for execution of appropriate and effective measures that prevent breeding.
- i. List TWO habitats that are commonly utilized by houseflies for breeding. (2)
  - ii. Discuss the reproductive life cycle of a housefly from the time a young fly matures until its progeny emerge and escape from the breeding site. (6)
  - iii. Discuss measures you may institute to reduce housefly breeding in the sites mentioned in (i) above. (4)
- c. Cockroaches DO NOT belong to the Order Diptera.
- i. Explain why cockroaches are not classified under the Order Diptera like houseflies.

- (2)
- ii. Explain why cockroaches are less important transmitters of human disease than houseflies. (4)
- iii. List TWO measures (or precautions) you may undertake to prevent cockroach multiplication in a household. (2)

[25 marks]

**QUESTION 3**

- a. Students in the Environmental Health department of the faculty of Health Sciences visit several microhabitats to collect arthropods at different developmental stages. A student identifies and collects larvae of mosquitoes from Lumphohlo near Mbabane.
- i. Do you think these are Anopheline or Culicine larvae? Explain. (3)
- ii. What feature, on site, can the student use to determine whether these are Anopheline or Culicine larvae? (2)
- iii. What features is the student likely to use in the laboratory to determine whether these are Anophiline or Culicine larvae? (Include how the student will use these features).
- iv. Suppose the student allows the larvae to develop into adult stages. What characteristics is he/she likely to use at the adult stage to determine whether these are Anophiline or Culicie larvae? (4)
- b. Later, the students in the Environmental Health Department visit the lowveld for further mosquito control field studies and characterization. They are taught methods for differentiating female and male *Anopheles* mosquitoes because only females transmit disease.
- i. Explain how female *Anopheles* mosquitoes may be differentiated from their male counterparts. (2)
- ii. Explain why only female mosquitoes, and not males, are involved in disease transmission. (2)
- iii. The students collect adult mosquitoes inside and outside a temporary shelter and upon characterization, find that the majority of them are *Anopheles arabiensis*. Describe TWO features of *Anopheles arabiensis* that influence large numbers being collected during this exercise. (4)
- iv. Describe TWO methods the students are likely to use while indoors to prevent bites of *Anopheles* mosquitoes and possible infection with malaria. (4)
- v. Describe TWO methods the communities infested with mosquitoes may institute to reduce breeding of *Anopheles* mosquitoes. (4)

[25 marks]

**QUESTION 4**

- a. Tsetseflies are important blood-feeders and hence are involved in transmission of disease in humans and animals.
- i. Name one disease prevalent in Africa that is transmitted by tsetseflies in humans and animals. (1)
- ii. How can you use the wing to identify a tsetsefly? (2)

- iii. Explain how you may use the antennae to identify a tsetsefly. (A drawing may be used to enhance your explanation). (3)
- iv. Describe the breathing mechanism used by all tsetseflies (A diagram may be used to enhance your description) (4)
- v. Tsetseflies consist of two club-shaped organs called halteres. Explain how these structures evolved and what their function is. (2)
- b. What is the function of the following parts of the internal structure of the tsetsefly:
  - i. crop? (2)
  - ii. malpighian tubules? (2)
- c. Discuss the reproductive cycle of the tsetsefly until the next progeny of young tsetseflies emerge and escape from the breeding site. (5)
- d. Discuss TWO strategies you may initiate in a community to reduce tsetsefly infestation. (4)

**[25 marks]**

**QUESTION 5**

A rural homestead requests your office for assistance with control of rodent infestation at their homestead. The first step you want to perform is determining the species infesting the homestead.

- a. Why is it important to determine the infesting rodent species? (2)
- b. Why is it important to also determine the degree of infestation prior to initiating control measures? (2)
- c. Discuss the steps you are likely to take to determine whether the homestead is infested with *Rattusrattus* or *Rattusnorvegicus*. (6)
- d. Rodent infestation may be reduced or removed using a bait and a suitable rodenticide.
  - i. Explain the importance of including a bait with the rodenticide. (2)
  - ii. Suppose the rodenticide you get for use is brodifacoum in a pellet form at 0.005% which causes death of the rodent in 4 – 12 days. Explain the method of functioning of brodifacoum. (3)
  - iii. What advantages does the death of the rodent occurring 4 – 12 days have in the process of rodent control. (2)
  - iv. Explain why brodifacoum is a better choice for the control of the rodents compared to warfarin. (2)
- e. Environmental manipulation is the best strategy to prevent future rodent entry into houses. List six (6) measures you may suggest to prevent rodent entry and re-infestation following elimination. (6)

**[25 marks]**

**QUESTION 6**

- a. Define each of the following terms as they apply to pesticide use and effect:
- Local effect (2)
  - LC<sub>50</sub> (2)
  - Occupational Exposure Limit (2)
- b. Pesticide application in the environment commonly lead to pollution of soil, water and air. Discuss two factors that affect the degree or extent to which a pesticide may pollute the soil, water or air. (4)
- c. A woman purchases a can of insecticide for use in the control of cockroaches in her house. The can has the following label:

D'D' Trans Cyphenothrin 0.20g/kg piperonylbutoxide 0.40g/kg Propoxur 10.0g/kg
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- Discuss the importance of each of the ingredients on the can. (4)
  - Do you think this can is a good buy for the elimination and control of cockroach infestation in the woman's kitchen? Explain. (4)
- d. A sprayman employed by the National Malaria Control Programme sprays a mud wall during indoor residual spray (IRS) to control mosquitoes.
- Do you think the sprayman would use DDT or pyrethroid? Explain. (3)
  - Explain why it is important for the sprayman to maintain the correct nozzle to wall distance during spraying. (4)

**[25 marks]**