

**UNIVERSITY OF SWAZILAND**

**MAIN EXAMINATION PAPER: MAY 2015**

**TITLE OF PAPER: APPLIED BIOLOGY**

**COURSE CODE: B405**

**TIME ALLOWED: THREE HOURS**

- INSTRUCTIONS:**
- 1. THIS PAPER IS DIVIDED INTO FOUR SECTIONS**
  - 2. ANSWER A TOTAL OF FOUR QUESTIONS, CHOOSING ONE QUESTION FROM EACH SECTION AND USING SEPARATE ANSWER BOOKLETS FOR EACH SECTION.**
  - 3. EACH QUESTION CARRIES TWENTY FIVE (25) MARKS**
  - 4. ILLUSTRATE YOUR ANSWER WITH LARGE AND CLEARLY LABELLED DIAGRAMS WHERE APPROPRIATE**

**SPECIAL REQUIREMENTS: NONE**

**THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATORS**

**[PLEASE TURN OVER]**

**SECTION A (Answer one question from this section).**

**Question 1**

- (a) Using specific examples, explain the key reasons for the emerging and re-emerging human diseases. (18 marks)
- (b) Explain the intervention strategies to combat the emerging and re-emerging diseases. (7 marks)

**[TOTAL MARKS = 25]**

**Question 2**

- (a) If  $r = 2.5$  per year for a polyetic pathogen, how much disease would you expect to observe? (2 marks)
- (b) Use Van de Plank's equation to state the principles behind plant disease control. (4 marks)
- (c) Write an essay on monocyclic and polycyclic diseases. (9 marks)
- (d) Distinguish between vertical and horizontal resistance to plant diseases. (10 marks)

**[TOTAL MARKS = 25]**

**[PLEASE TURN OVER]**

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**SECTION B (Answer one question from this section)**

**Question 3**

Identify five of the earth's life support systems. For each of these, describe their causes and consequences of overextending them, with particular reference to invertebrates.

(25 marks)

**[TOTAL MARKS = 25]**

**Question 4**

(a) Compare and contrast a traditional and modern agroecosystem with regards to the following:

(i) floral and faunal diversity,

(5 marks)

(ii) age of plants,

(5 marks)

(iii) resource utilisation and inputs.

(5 marks)

(b) Explain factors which contribute to the development of pest status in species.

(10 marks)

**[TOTAL MARKS = 25]**

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SECTION C (Answer one question from this section)

Question 5

Study the three case studies below and answer the questions that follow.

**Case study 1**

Remains of a person, believed to be those of Mr Tafara Mukoko who went missing a year ago in Maliyaduma village, were found in a shallow grave just 100 metres away from his homestead. Mr Mukoko left behind a wife (Melinda) and three daughters (Ayanda, Lerato and Temaswati). Microsatellite fingerprints of Melinda and her daughters are given below.

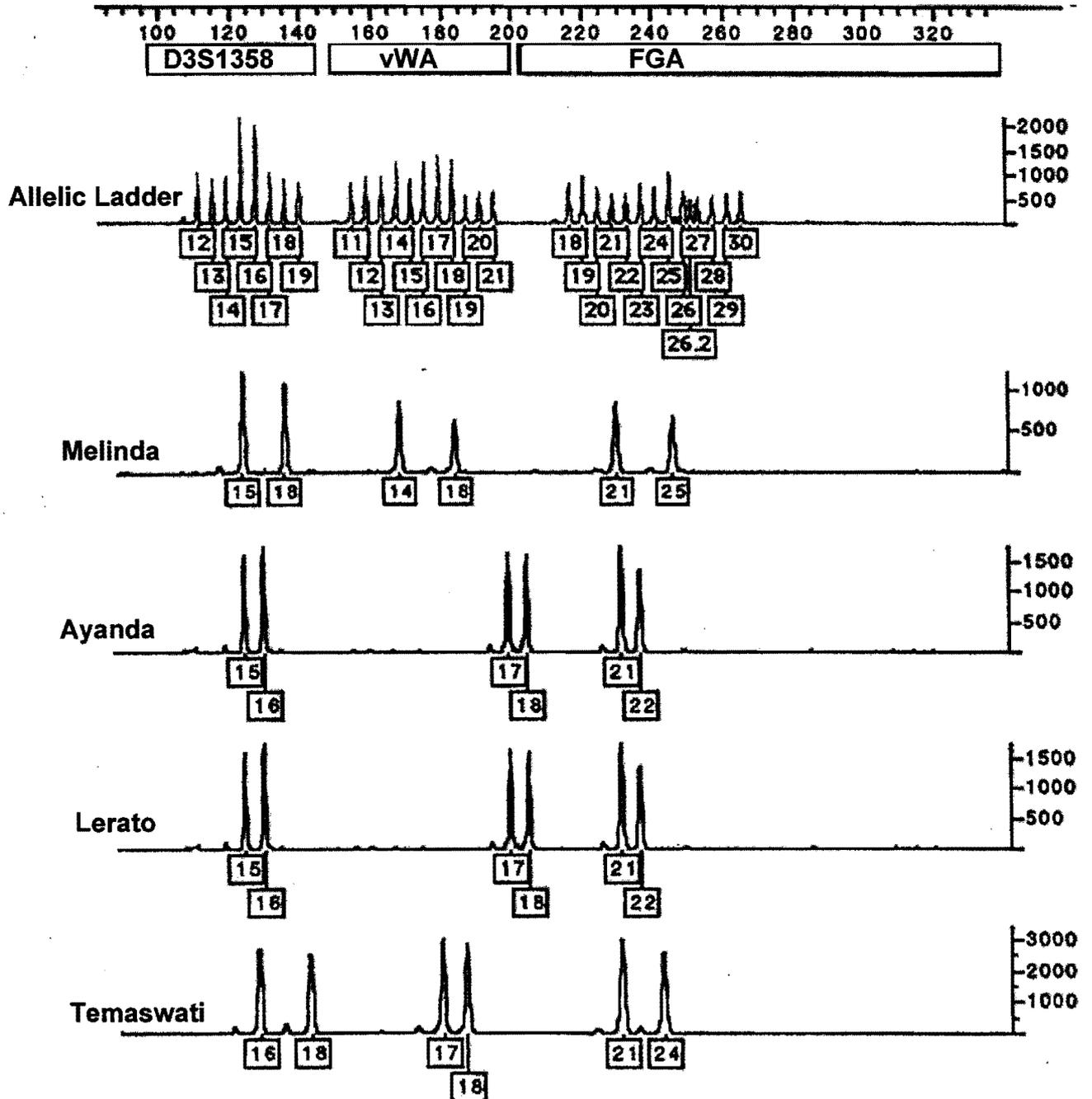


Fig 1: Microsatellite profiles for Melinda and her daughters

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**Case study 2**

A civil war in Somalia displaced a lot of families and separated or scattered family members into different locations. Three siblings comprising two brothers (Rajid and Asaad) and one sister (Melissa) decided to identify their parents from whom they got separated 25 years ago. They found a couple who resembled their parents (from old pictures they kept in a family album) but to be sure, they had to do some DNA tests of themselves and those of the suspected parents. Their STR profiles are as given in Table 1 below.

Table 1: Microsatellite profiles for three siblings.

Locus	Rajid	Asaad	Melissa
D3S1358	18, 18	18, 18	15, 16
vWA	16, 18	16, 18	16, 17
D8S1179	13, 15	13, 15	13, 15
TH01	9.3, 10	9.3, 10	6, 9.3
CSF1PO	12, 12	11, 12	12, 12

**Case study 3**

Three people, Zwely, Charles and Nosimilo are involved in a love triangle where a baby girl is a subject of a paternity wrangle between Nosimilo and Zwely. Nosimilo, the mother of the girl alleges that Zwely is the biological father, an assertion he disputes citing his knowledge of Charles' possibility as a father. Nosimilo knows very well that Charles is the true fathers of her child, but because he doesn't have a well-paying job, she prefers to pin Zwely and stick to him as the father. In your forensics lab you take DNA samples from the above four people.

- (a) (i) What is DNA fingerprinting? (1 mark)  
(ii) Explain the role of the allelic ladder in Fig 1. (1 mark)  
(iv) At locus **D3S1358**, what does the number "16" represent? (1 mark)  
(v) Explain the advantage(s) of the marker used in **Case 1**. (3 marks)
- (b) Do the microsatellite profiles in Fig 1 support the fact that the remains found in the shallow grave are those of Mr Tafara Mukoko? Explain your answer, giving Mr Mukoko's DNA fingerprint if possible. Also indicate how you would determine the gender of the person found in the grave. (6 marks)
- (c) Use the STR alleles in Table 1 to decipher the possible genotypes of the parents. (6 marks)
- (d) Explain how you would unequivocally exonerate Zwely from Nosimilo's paternity fraud. (6 marks)

**[TOTAL MARKS = 25]**

**Question 6**

Evaluate application of serum (iso)enzymes in clinical pathology. (25 marks)

**[TOTAL MARKS = 25]**

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## SECTION D (Answer one question from this section)

## Question 7

- (a) Define 'ecosystem service' and give two examples of such services. (6 marks)
- (b) Using two instrumental values that a conservation biologist might use, make an argument against the destruction of biodiversity. (8 marks)
- (c) An important issue in wetland conservation is the potential impacts of nutrient runoff from adjacent land uses on wetland biodiversity. A scientist samples six different wetlands in two different areas (A and B) of Matsapha. Her data are given in the following table, which shows the average water phosphorous concentration ([P], in  $\mu\text{g/L}$ ), plant species richness (S) and proportion of unique species (U, the proportion of species which are not found in any other sampled wetland) for each wetland.

[P] in $\mu\text{g/L}$		S		U	
A	B	A	B	A	B
18	4	117	58	0.02	0.56
26	6	154	67	0.03	0.50
14	9	108	88	0.01	0.42
33	16	173	109	0.06	0.23
12	11	97	91	0	0.33
22	13	128	103	0.04	0.30

On the basis of these data, it is argued that in area B, we needn't be so concerned about nutrient runoff from adjacent lands because even if wetland nutrient concentrations increase, this will serve to increase rather than decrease wetland species richness. On the basis of the data presented above, do you agree or disagree with this argument? Explain. (11 marks)

[TOTAL MARKS = 25]

## Question 8

Discuss 5 major direct threats to Swaziland's biodiversity. (25 marks)

[TOTAL MARKS = 25]

END OF QUESTION PAPER