

UNIVERSITY OF ZAMBIA
 UNIVERSITY EXAMINATIONS - 1999
 FIRST SEMESTER
 SCHOOL OF AGRICULTURE SCIENCES

1	AGA	211	-	Comparative Anatomy of domestic Animals
2	AGA	211	-	Comparative Anatomy of domestic animals - Sup
3	AGA	311	-	Principles of Animal Nutrition
4	AGA	351	-	Animal Science
5	AGA	442	-	Integrated agriculture and Fish nutrition
6	AGC	211	-	Fundamentals of Crop production
7	AGC	211	-	Fundamentals of Crop production - Def
8	AGC	521	-	Plant Breeding II
9	AGE	211	-	Fundamentals of micro - economics
10	AGE	411	-	introduction to Agribusiness management
11	AGE	531	-	International Agricultural trade
12	AGE	541	-	Project planning and Appraisal
13	AGF	211	-	General microbiology - theory paper
14	AGF	221	-	Computer sciences - Def
15	AGG	311	-	Statistics
16	AGS	211	-	Fundamentals of Soil Science
17	AGS	411	-	Soil fertility
18	AGS	431	-	Soil mineralogy and micro morphology
19	AGS	531	-	Land Evaluation and improvement
20	AGS	551	-	Planning and development of irrigation and drainage system

THE UNIVERSITY OF ZAMBIA
DEPARTMENT OF ANIMAL SCIENCE

END OF FIRST SEMESTER (1999) FINAL EXAMINATIONS
COMPARATIVE ANATOMY OF DOMESTIC ANIMALS

AGA 211

TIME ALLOWED: 3 HOURS

INSTRUCTIONS: Answer All Questions. They carry equal marks.
Write your answers within the question paper.

- Q1.** Figures 1 and 2 show female reproductive organs of different species. Figure 3 shows a graafian follicle.
- (a) **With reference to Figure 1,**
 - (i) Identify each of the organs with a particular species. Label all parts of the organs.
 - (ii) How can you describe the "design" of these reproductive organs?
 - (iii) In which species would you expect multiple offspring? Why?
 - (iv) In natural mating, place an x where the male animal would deposit sperms.
 - (v) Describe briefly the differences in the cervix of each species.
 - (b) **With reference to Figure 2,**
 - (i) Identify the species bearing this type of reproductive system. Label parts 1 through 7.
 - (ii) Describe in only one sentence the function of each part above.
 - (c) **With reference to Figure 3,**
 - (i) Label parts A through J.
 - (ii) What is contained in E?
 - (iii) Describe steps (from primary follicle) leading towards the formation of the graafian follicle. What is significant about this stage?
 - (iv) When the graafian follicle ruptures to release the ovum, what is formed at that point, and what is the function of this formed body?
- Q2.** Figure 4 shows a diagram illustrating the general organization of the autonomic Nervous system.
- (a) Please identify the sympathetic and parasympathetic nervous systems (thickened lines or narrow lines). What are the other terms used to describe the two systems, based on their outflow?

- (b) Where are the cells of origin of the visceral efferent fibres of the sympathetic nerves located?
- (c) What is the function of the sympathetic ganglia?
- (d) The general anatomic arrangement of the sympathetic system is to have a pre-ganglionic fibre synapsing into a post-ganglionic fibre which then travels to an organ. What is one Exception to this general arrangements?
- (e) What are the names of the parasympathetic nerves labelled III, VII, IX and X?
- (f) Briefly describe the relationship between the Autonomic nervous system and the endocrine system.

Q3. Refer to Figures 5 and 6.

- (a) With reference to figure 5,
 - (i) Label the parts shown.
 - (ii) In what livestock species is this organ found? What is it generally referred to as?
 - (iii) What is the largest component of this organ?
 - (iv) Compare this organ with that found in a 3-day old animal of the same species.
 - (v) In one or two sentences, describe the function (s) of each of the components of this organ.
- X (b) With reference to figure 6 (a,b,c),
 - (i) Identify the type of epithelium and where it is found in the GIT of a ruminant animal.
 - (ii) Where is the type of epithelium in Figure 6 (c) predominant in the part of the GIT where it is found? Why?
 - (iii) Briefly describe the function of the Esophageal groove in a young ruminant animal.

Q4. Figure 7 shows part of the bovine skeletal system, divided into vertebral regions.

- (a) Please label vertebral regions 1 through 5.
- (b) Give the vertebral formula for the bovine.
- (c) Draw sketches of the following vertebra to show that you understand the anatomical differences:
 - 3rd cervical vertebra
 - Lumbar vertebra
 - Thoracic vertebra
- (d) What are the cervical vertebrae specialized in?
- (e) Label the following bones in figure 7: Scapula, Femur, Tibia, Radius.

Q5. Figure 8 shows the pituitary gland (hypophysis) of a pig.

- (a) Please label the parts shown.
- (b) Which hormones are produced by the anterior part of this gland?
- (c) What is the major function of the neurohypophysis?
- (d) Briefly describe the hypothalamo–hypophyseal–gonadal axis.

END OF EXAMINATION

FIGURE 1

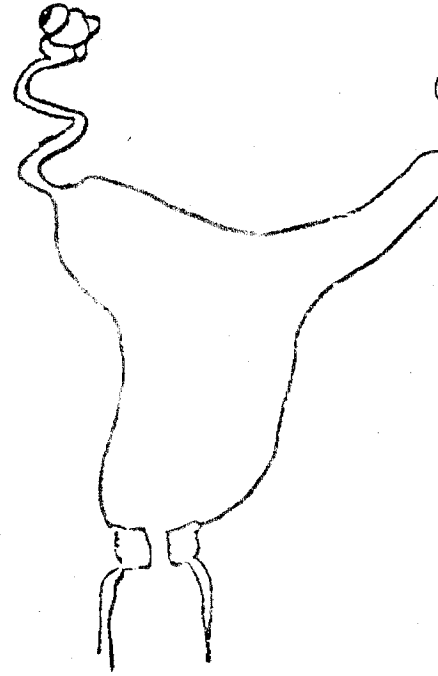
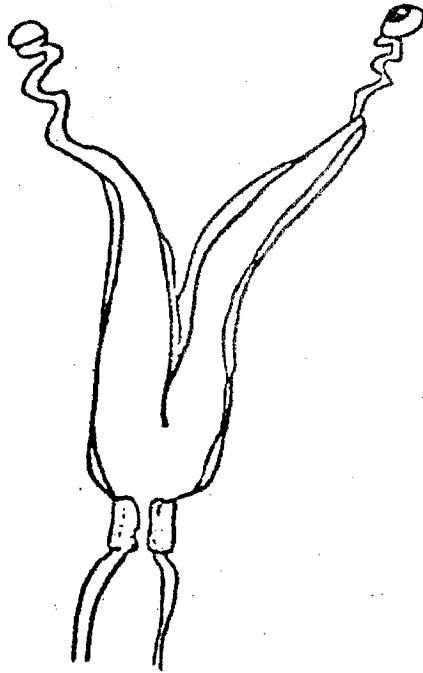
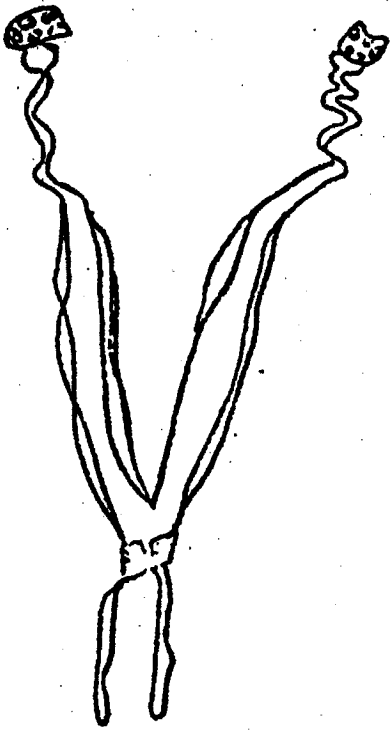


FIGURE 2

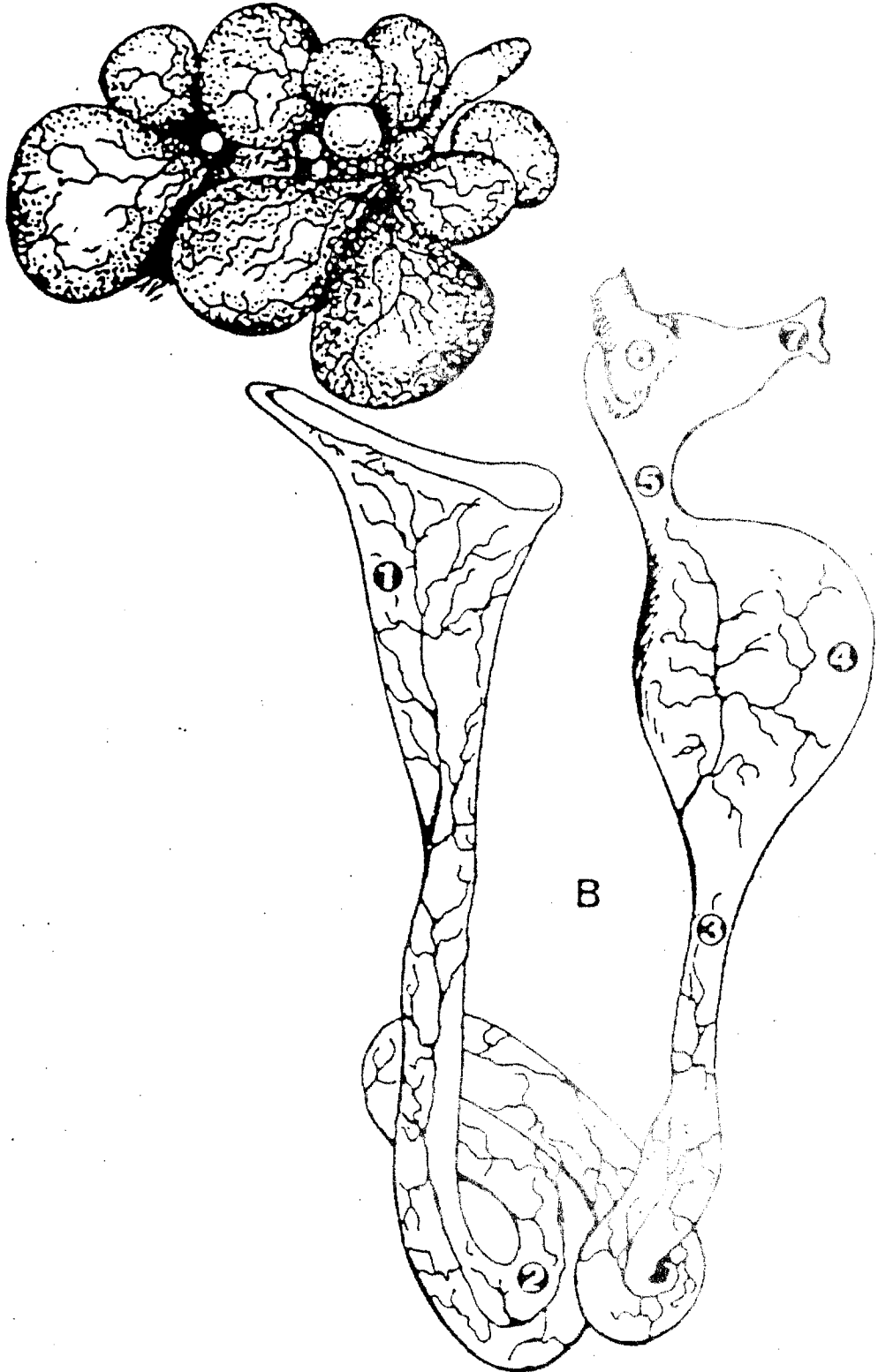
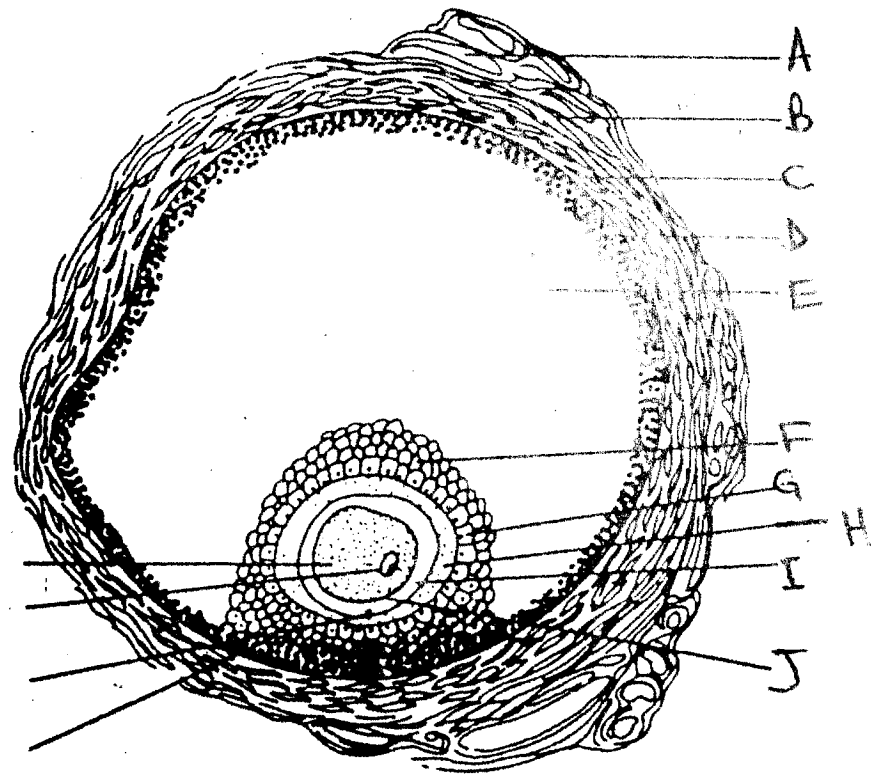


FIGURE 3

THE MATURE ANTRAL (GRAAFIAN) FOLLICLE



7-181129 4

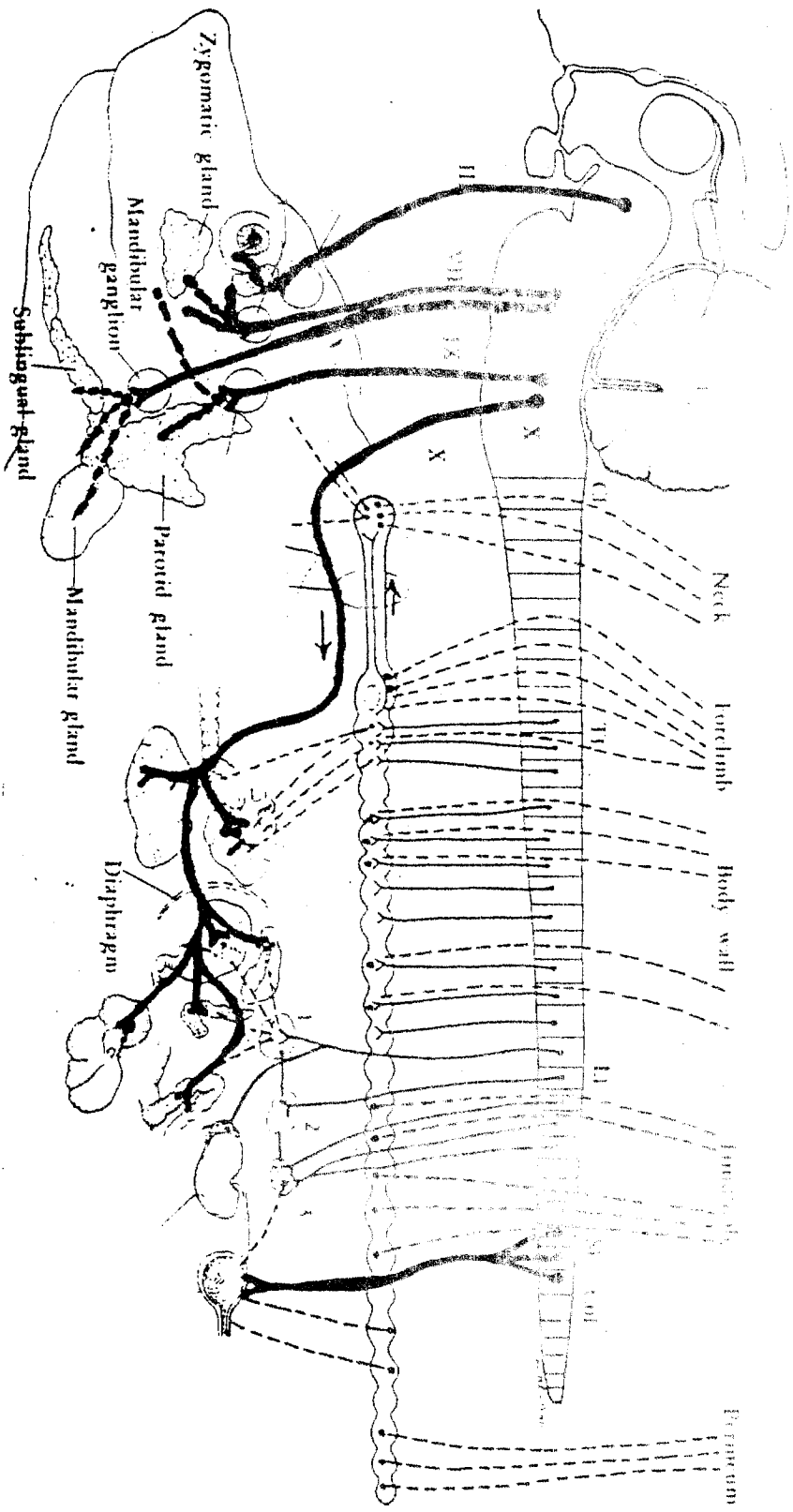


FIGURE 5

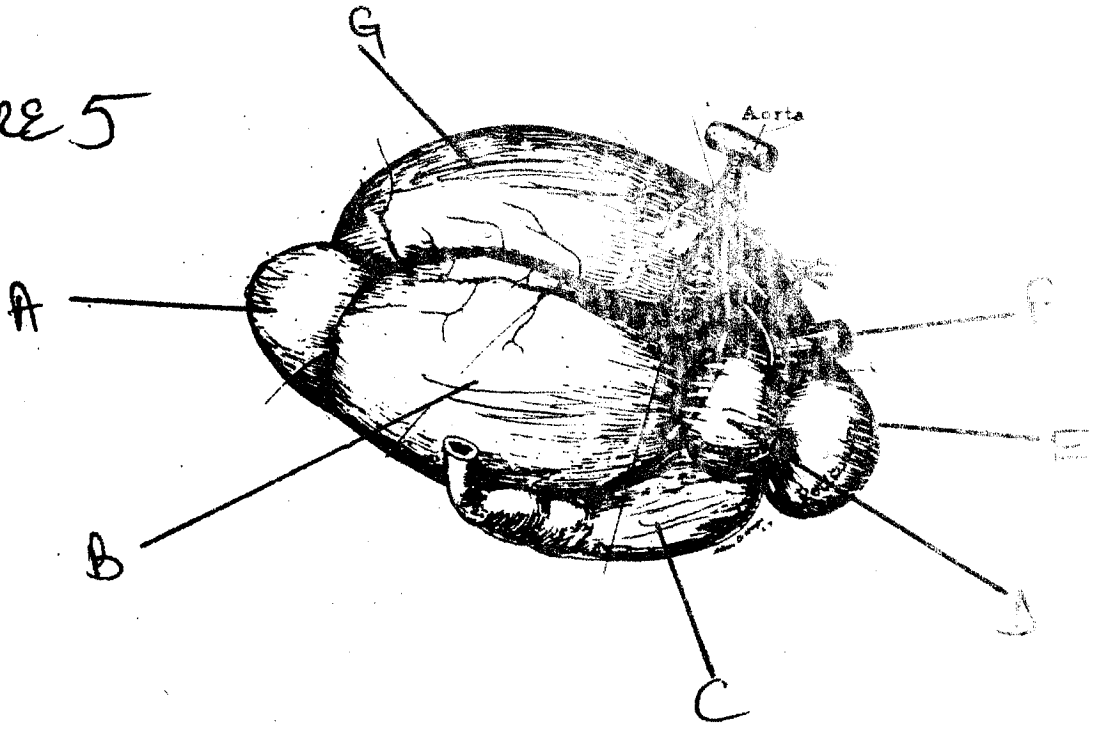


FIGURE 6(a)

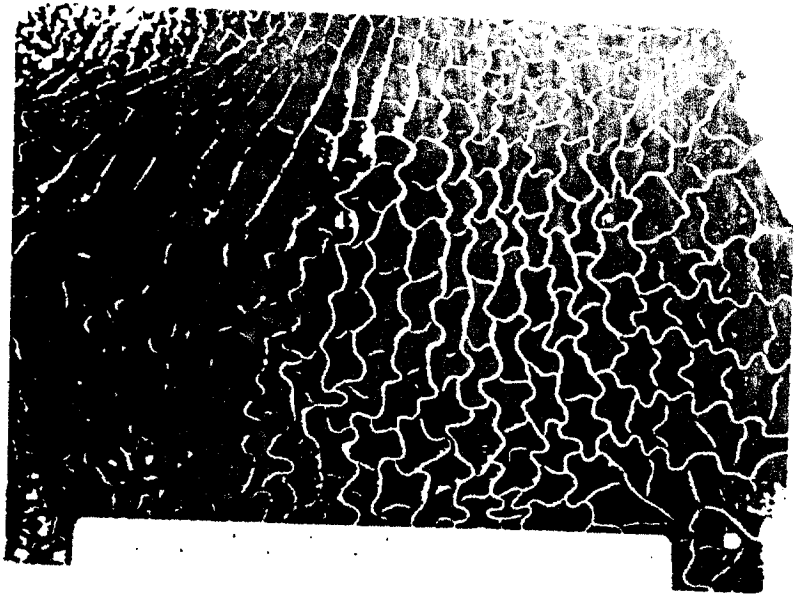


FIGURE 6(b)



FIGURE 6(c)

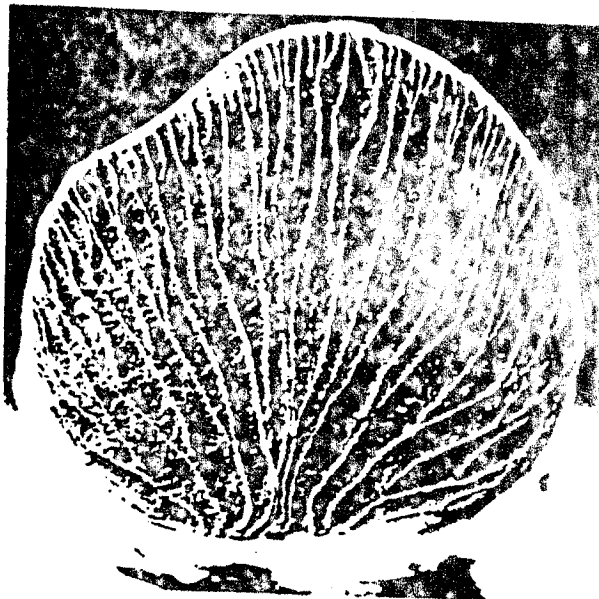


FIGURE 7

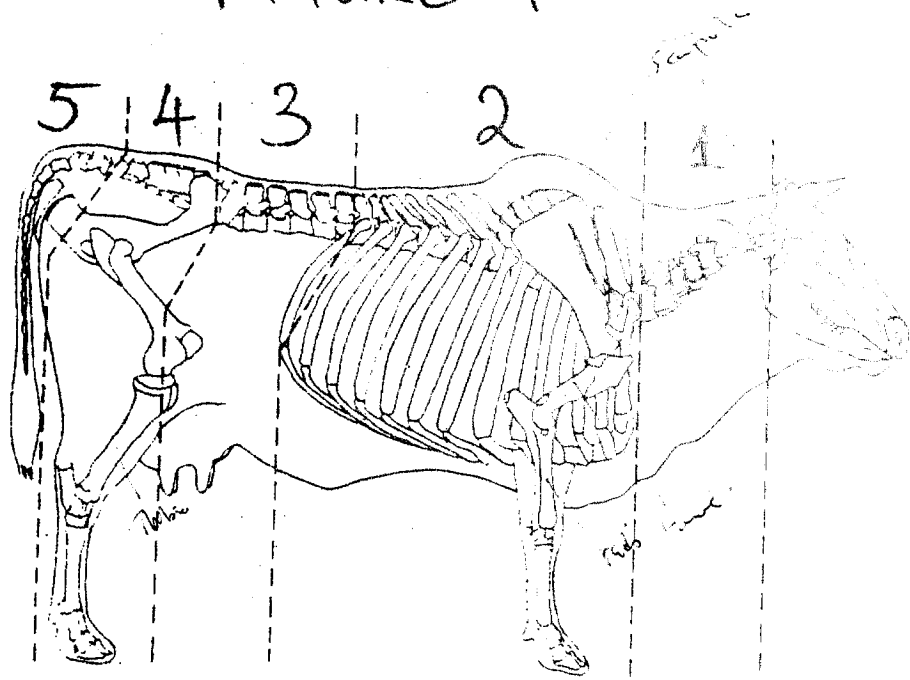
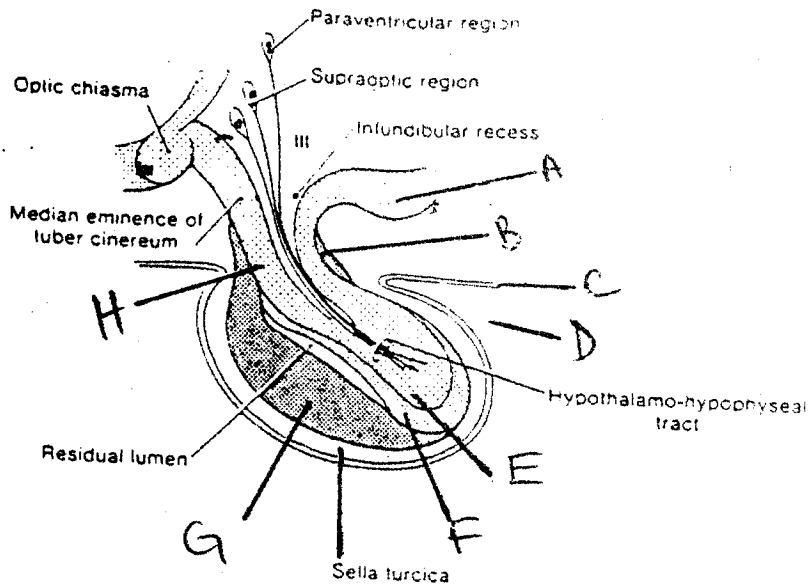


FIGURE 8



**THE UNIVERSITY OF ZAMBIA
DEPARTMENT OF ANIMAL SCIENCE**

**END OF FIRST SEMESTER (1999) SUPPLEMENTARY DEFERRED
EXAMINATIONS**

**COMPARATIVE ANATOMY OF DOMESTIC ANIMALS
AGA 211**

TIME ALLOWED: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS. THEY CARRY EQUAL MARKS.

- Q1. (a)** Draw and fully label a cell from the Longissimus dorsi muscle of an ox.
- (b) Choose any region of the ox and name any three (3) muscles from that particular region.
- Q 2 (a)** Draw and label the fore stomach of a mature ruminant.
- (b) Compare this with the fore stomach of a two-day old ruminant.
- Q3.** Draw the vertebral column of a sheep, labelling all the vertebra . Also show how the spinal nerves emerge; label them to show that you understand their anatomical arrangement.
- Q4.** Draw a detailed structure of the heart and label all the major parts including the associated blood vessels.

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER FINAL EXAMINATIONS OCT. 99

COURSE : AGA 311
PRINCIPLES OF ANIMAL NUTRITION

TIME 3HOURS

INSTRUCTIONS: READ THE QUESTIONS CAREFULLY AND ANSWER AS REQUIRED. NOTE THAT THERE ARE COMPONENTS AND CHOICE WITHIN MOST QUESTIONS.

1. A) Give brief answers to five (5) of the following.

- i) Name the essential fatty acids (EFA) and their dietary sources.
- ii) Why are EFA important to the animal's nutritional status?
- iii) Give three essential fatty acid deficiency symptoms in the Pig.
- iv) What is rancidity and what causes it in animal feeds?
- v) Briefly contrast the significance of starch to cellulose in the pig and the cow.
- vi) How are different species adapted in nitrogen disposal mechanisms?
- vii) Why is water and its quality important to farm animals?

B) Define four of the following and state what is the important principle behind each of them:

- Protein Efficiency Ratio (PER)
- Net Protein Utilization (NPU)
- Biological Value (BV)
- Chemical Score and
- Gross Protein Value (GPV).

(15 Points)

2. A) Choose either vitamin A or vitamin D and discuss the following briefly:

- i. Give three physiological functions of the vitamin of your choice.
- ii. Give three deficiency symptoms.
- iii. Give two good sources of the vitamin.

B) i. On the farm setting, when are these two vitamin deficiencies likely to occur and why?

- ii. What symptoms are associated with vitamin D toxicity?

(10 Points)

3. The water-soluble vitamins and minerals are important in the growth of farm animals. Briefly, answer each of the following:

- a) What are the major functions and give three examples of the water-soluble vitamins.
- b) Give three good sources for each of the water-soluble vitamin mentioned above.
- c) Give three specific symptoms associated with any of the water-soluble vitamins given in b.
- d) Why is the calcium: phosphorus ratio important in growing animals.

(10 Points)

4. You are a consultant in livestock rations. You have been contracted to design calf feed. You know that calves are sensitive to calcium deficiency. Thus, you want to make sure the dietary calcium will meet the growth requirements. Therefore, you have decided to test the true digestibility of this calcium using radio- isotope calcium (^{42}Ca). Radio -isotope calcium was injected intravenously during the feeding period.

The analysis of the data collected showed dietary calcium to be 0.8%, fecal Ca was 0.7%. The radio isotope specific activity for plasma ^{42}Ca was 6% and in the feces 3%.

- a) What is the apparent digestibility of this calcium?
- b) What is the true digestibility of this feed calcium?
- c) Are the two values different and why or why not?
- d) What are the disadvantages of the two methods for estimating digestibility?
- e) What advice would you give to a miller if they had designed this ration?

(15 Points)

5. With the help a flow-chart where possible briefly discuss (5) six of the conditions and give valid farm animal examples for each:

- a) Disaccharide intolerance.
- b) Ketosis in farm animals.
- c) Dark cutting meat.
- d) Absorption of lipids and storage in adipose tissue.
- e) The fate of blood glucose.
- f) The fate of dietary proteins.
- g) AZUTORIA in animals.

(15 Points)

6. Using flow-chart for partition of food energy, define the components of gross energy.

- a) What is the heat increment of an animal and how does it affect the basal metabolic rate (BMR)?
- b) A respiratory exchange experiment was conducted and the data is provided below involving heat production of a calf kept for 24hrs. in a respiratory chamber.

Data collected:

Oxygen consumed = 200 liters

Carbon dioxide produced = 170 liters

Nitrogen excreted in urine = 10 grams

Calculate:

- h) Heat production from protein metabolism.
- ii) Heat production from carbohydrate and fat metabolism.
- iii) The total heat produced.

Assumption:

Ratio of Oxygen in protein = 0.96

Ratio of Carbon dioxide in protein = 0.77

Non protein respiratory quotient (RQ) = 0.79

Thermal equivalent of Oxygen at RQ = 0.79 = 4.8 kcal

(15 Points)

7.

Answer two of the following:

- A) With examples show how food intake is regulated in the
 - i) short term
 - ii) long term
 - iii) list the factors affecting food intake in the ruminant animal
- B) In a flow-chart show how the products of rumen fermentation are absorbed in the ruminant animal.
- C) Discuss how the ruminant animal treats dietary protein and its advantages and disadvantages.

(20 Points)

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS - MAY, 1999

AGA 351

ANIMAL SCIENCE

~~TIME~~: **THREE (3) HOURS**

INSTRUCTIONS TO CANDIDATES:

ANSWER ANY FIVE (5) QUESTIONS FROM SECTION A (60 MARKS), AND ANY TWO FROM SECTION B (40 MARKS).

SECTION A

1. a) Describe the various types of joints found in a named domestic animal. b) Are joints and muscles necessary in our domestic animals? Discuss.
2. A stable 'internal environment' (homeostasis) is maintained by the hypothalamus of the animal brain. a) Describe the physiological processes involved in the regulation of body core temperature. b) Is fever a breakdown in the maintenance of body temperature? Discuss.
3. The digestive systems of the ruminant and the non-ruminant are different.
 - a) What are the functions / roles of the micro-organisms found in the ruminant stomachs.
 - b) What are the enzymes secreted by the stomach of the non-ruminant animal such as the pig and indicate their functions in the stomach.
 - c) How can animal scientists and farmers put this difference between ruminants and the non-ruminants into practical use?
4. Artificial selection is carried out using several methods by the animal breeder / farmer to improve the level of performance of livestock in particular traits. Explain how the following selection methods are carried out and discuss their advantages and disadvantages: a) Pedigree selection b) Sib-testing / Family selection c) Progeny testing.

5. Meiosis is a process of cell division leading to gamete formation. a) Explain in detail the sequence of events that take place during Prophase I of Meiosis. b) Discuss the importance / significance of meiosis.
6. The oestrus cycle, is controlled by hormones from the pituitary glands and the ovaries. a) Name the hormones b) What are the signs of heat in cows c) Artificial insemination in the dairy industry is now very popular. What are the advantages and disadvantages of using artificial insemination over natural mating?

SECTION B

7. a) What are the main problems or constraints of beef ranching in Zambia? b) Discuss the routine management practices you would carry out from calving to weaning on a beef ranch of your choice.
8. a) Discuss the potential and constraints (problems) of the pig (swine) industry. b) Outline the main points you would consider in sow selection.
9. a) Discuss the problems that need to be overcome for increased production in the poultry industry. Describe the three major types of poultry production systems. Which one would you recommend to an upcoming farmer and why?

THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS - OCT / NOV 1999
DEFERRED / SUPPLEMENTARY EXAMINATIONS
ANATOMY, PHYSIOLOGY AND HUSBANDRY OF DOMESTIC ANIMALS
AGA 351

TIME : THREE (3) HOURS

INSTRUCTIONS TO CANDIDATES:

ANSWER ANY FIVE (5) QUESTIONS FROM SECTION A (60 MARKS), AND ANY TWO (2) FROM SECTION B (40 MARKS).

1. a) What are the physiological functions of water in the animal body and what are its (water) sources?
b) Why are some amino acids referred to as essential or indispensable? List down the essential amino acids and any three (3) non-essential amino acids.
c) What are the functions of calcium (Ca) and phosphorus (P) in the body of the animal and what are the their sources.
2. a) The skin is a stratified squamous epithelium that is continuous with membranes at natural openings. What are its functions?
b) The lungs are important for gaseous exchange. What are the other related functions?
3. a) The skin and lungs are important organs of the body. Describe how they are involved in thermoregulation.
b) One of your farm animals has been diagnosed with fever. Discuss what you think is happening to the animal's body temperature.
4. a) Genetics is indebted to the Austrian monk Gregor Mendel. State the 2 principles or laws he is credited with?

- b) State the law of equilibrium that Hardy and Weinburg proposed in 1807. Discuss the factors that act on a population to change this equilibrium.
5. Artificial selection is carried out using several methods by the animal breeder / farmer to improve the level of performance of livestock in particular traits. Discuss which method you would recommend to an upcoming farmer with a large breeding herd and why that particular method was selected.
6. a) What is the main genetic consequence of selection?
- b) What do you understand by the terms cross breeding and inbreeding. Discuss their effects and use in animal breeding.

SECTION B

1. In an agricultural meeting, you are asked to suggest ways of improving the size and reducing the price of chickens sold in your area by changing from a traditional, extensive, free range system to something else. What would your suggestions be?
2. A farmer friend of yours says that he does not eat pork or keep pigs because of religious beliefs. State how you would try to convince him of the benefits of rearing pigs.
3. As a farm manager, discuss the routine management practices done from calving to weaning on your beef ranch. Also, outline the main points to consider in the timing of calving.

**THE UNIVERSITY OF ZAMBIA
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ANIMAL SCIENCE DEPARTMENT**

**AGA 442 EXAMS / INTEGRATED AQUACULTURE AND FISH NUTRITION
IIND SEMESTER 1998-1999.**

Instructions:

Time: 3 hours

Answer all the questions

Question 1 (4pts): What are the most important natural spawning factors of *Cyprinus carpio* and *Clarias gariepinus* and what are the substrates needed for the two species?

Question 2(4pts): What are the most important factors to control in hatchery and what is the relationship between the incubation periods and these factors?

Question (10 pts) 3: Between one and two weeks after hatching the fry start to feed on food .

- a. What is the most important food for fry and how many days the hatched fry start to ingest it?
- b. What happens if no food is ingested during the first week ?
- c. How the fry survive the first three days without external food ?
- d. How is prepared the Handy-Type-Micro diet feed for fry at Mwekera?
- e. In case of *Tilapia* species how is the natural incubation?

Question 4(4pts): a. What is the formula of total amount of food to be distributed per hectare?
b. How to obtain the relative food conversion rate?

Question5 (4pts): What forms of integrated aquaculture do you know?

Question 6 (10pts): In the case of integration of aquaculture and irrigation, what are different techniques identified in Zambia?

Question 7 (4pts): It is best not to spread the manure all over the pond bottom but instead to stack it in heaps or in rows at regular intervals. Why?

Question 8 (10pts): Illustrate animal husbandry and the fish farming interrelationships.

Total: 50pts

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
ANIMAL SCIENCE DEPARTMENT**

**AGA 442 EXAMS / INTEGRATED AQUACULTURE AND FISH NUTRITION
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ANIMAL SCIENCE DEPARTMENT

AGA 442 EXAMS / INTEGRATED AQUACULTURE AND FISH NUTRITION
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ANIMAL SCIENCE DEPARTMENT**

**AGA 442 EXAMS / INTEGRATED AQUACULTURE AND FISH NUTRITION
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ANIMAL SCIENCE DEPARTMENT**

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THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS MAY 1999

AGC 211

FUNDAMENTALS OF CROP PRODUCTION

TIME: THREE HOURS

INSTRUCTION(S):

a. Answer five questions. All questions carry equal marks.

1. Write short notes on the following:
 - (a) The relationship between plant physiology and crop production. (5 marks)
 - (b) Apoplast and symplast modes of water movement in the root system of a vascular plant. (5 marks)
 - (c) Active transport of nutrients in plants. (5 marks)
 - (d) Cyclic phosphorylation. (5 marks)
2. Based on fundamental thermodynamic principles, explain the process of water uptake and transport from the soil to the xylem of a vascular plant. (20 marks)
3.
 - (a) Explain at least six major reasons which necessitate tillage operations in arable farming. (10 marks)
 - (b) Explain at least four major soil factors which affect absorption of water from the soil by vascular plants. (10 marks)
4.
 - (a) Outline the four salient features which are embodied in agroforestry definitions. (6 marks)
 - (b) Distinguish between C_3 and C_4 plants. How can their physiological differences be used in designing agroforestry technologies. (14 marks)
5. With the aid of a diagram, describe the process of carboxylation in the malate forming type of C_4 plants. (20 marks)
6. Economic yields in crop production are achieved by optimizing growth factors through crop husbandry. Discuss at least six crop husbandry practices which lead to optimization of growth factors. (20 marks)

THE UNIVERSITY OF ZAMBIA
UNIVERSITY DEFFERED EXAMINATIONS
DECEMBER, 1999

COURSE: FUNDAMENTALS OF CROP PRODUCTION (AGC 211)

TIME ALLOWED: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS (MARKS AS INDICATED)

- Q1.** The family cruciferae is an important family in the diet of man.
- a. Describe the main features of the family cruciferae. (10)
 - b. Name two crops belonging to this family, giving both their common and botanical names. (6)
 - c. What is the economic importance of this family. (4)
- Q2.** Several factors influence photosynthesis. **Discuss in detail** how each of the factors affect photosynthesis. (20)
- Q3.** Using your knowledge of **crop science**, explain in detail why it is advantageous to grow crops in a mixture as opposed to a monocrop. (20)
- Q4**
- a. Write short notes on each of the following:
 - i. Gibberalins (3)
 - ii. Sources and sinks (3)
 - iii. Light reaction (3)
 - iv. CAM plants (3)
 - b. Explain how soil pH affects the status of phosphorus in the soil. (8)
- Q5.** Give a **detailed account** of the processes in which C₃ and C₄ plants fix CO₂. (20)

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES**

UNIVERSITY EXAMINATIONS OCTOBER 1999.

AGC 521 PLANT BREEDING 11

TIME: 3 HOURS

ANSWER ALL QUESTIONS

ALL QUESTION CARRY EQUAL MARKS

-
- | | |
|---|--------------|
| | Marks |
| 1. Write short notes on the following: | (20) |
| a. Mechanisms of insect resistance in plants. | |
| b. Passport data in Germplasm conservation. | |
| c. How would you apply a combination of honeycomb and mass selection methods in maize breeding? | |
| d. Moving means in early generation selection. | |
| e. Truncation selection. | |
| 2. <u>ANSWER EITHER 2 OR 3</u> | (20) |
| <p>It has been observed that the problem of 'pops' in groundnuts is due to calcium deficiency. Groundnuts have shown tremendous variation in their ability to uptake calcium from the soil.</p> <p>A soil scientist conducted an experiment to determine how the roots of groundnuts react in the absence of calcium in the soil. He discovered that plants of groundnut varieties that are efficient in utilizing soil calcium when grown in solution, lower the pH of the soil solution while the inefficient plants do not. The soil scientist concluded that roots of efficient plants exude an acid and that it is this acid which dissolves the calcium in the soil to make it available to plants.</p> <p>If you were asked to join the soil scientist in your capacity as a plant breeder/geneticist in this project, what kind of experiments would you suggest to be carried out to study this trait and how would you use the results in practical plant breeding to improve groundnut varieties in soil calcium uptake to reduce the problem of 'pops'.</p> | |
| 3. A population of pearl millet was investigated for harvest index using the North Carolina Design II. The experiment consisted of all possible crosses among 5 lines designated as males and 5 lines designated as females. Five progeny plants were grown from each cross as single randomized plants in four replications or blocks. The Analysis of variance table is given below: | (20) |

Table 1. Analysis of Variance of Harvest Index using the NCD II Method.

Source of Variation	df	ss	ms	P	E.M.S
1. Males (M)	4	2343	.....	**	$\sigma^2_w + 20\sigma^2_{mf} + 100\sigma^2_m$
2. Females (F)	4	2379	594.75	**	$\sigma^2_w + 20\sigma^2_{mf} + 100\sigma^2_f$
3. M x F	16	5463	.....	**	$\sigma^2_w + 20\sigma^2_{mf}$
4. Blocks (B)	3	47.13	15.71	NS	
5. M x B	12	299	24.92	NS	
6. F x B	12	.....	64.92	NS	
7. M x F x B	48	2903	60.48	NS	
8. Within families	400	.....	67.82		σ^2_w
9. Pooled within families (4,5,6,7,8)	.....			
Total	499				

NB **,NS designated significance and non significance at the probability level of $\alpha = 0.05$ respectively.

- (a) Complete the ANOVA table.
 - (b) Estimate the additive and Dominance genetic variances and comment on the magnitude of the narrow sense and broad sense heritability estimates of this trait with regards to the Plant Breeding Approach you would take to improve this trait in pearl millet.
4. (a) What do you understand by the term "Crop ideotype"? (20)
- (b) Suppose you were asked to develop an ideotype for sorghum; with your expert knowledge of genetics and plant physiology, what would be your ideotype for this crop.
 - (c) What genetic consideration would you take into account before you decide to use this phenomenon as a selection criteria in sorghum improvement.

5. (a) List the anticipated gains from wide crosses in crop plants. (20)
- (b) List and briefly discuss two achievements from wide crosses using chromosome manipulations.
- (c) How does genetic engineering differ from the method of chromosome manipulations and what potential applications does genetic engineering open up for crop improvement?

6. There was a report in the Time of Zambia that villagers in Lusitu were eating grass. On further investigation it was found that the people were surviving on grain from a weedy grass called Lupunga (*Echinochloa colona*). The Vice President of the of the Republic of Zambia then gave a directive that Agricultural Researchers should start research on this weed to transform it into a food crop.

Suppose you were included in a team of scientists given the task to commence research on this crop, as an expert in Germplasm conservation and Plant Breeding, what would be your specific expert contribution to the development of this weed into a viable food crop? (20)

***** END OF EXAMS *****

UNIVERSITY OF ZAMBIA

University Examinations - First Semester Examinations

May, 1999

AGE 211: Fundamentals of Micro-Economics

Instructions: Answer ALL questions in Section A and any FOUR from Section B Time: 3 hrs

Section A: *Multiple choice questions: Answer all questions on the question paper and hand it in together with the answer booklet* (20 marks)

1. The price mechanism allocates resources to those who can pay the market price T/F
2. The law of diminishing returns is also known as the law of variable proportions T/F
3. In the short run a firm will continue to produce as long as total revenue covers fixed costs T/F
4. Demand tends to be more elastic in markets with low per capita income and many substitutes than in those with high income and few substitutes T/F
5. The short run demand curve for a pure competition firm is given by $P = AR = MR$ T/F
6. Under imperfect competition the price is normally higher than the marginal revenue T/F
7. Opportunity cost refers to:
 - A. The revenue or earnings forgone as a result of a missed opportunity
 - B. Additional expenditure incurred as a result of failing to anticipate a rise in prices
 - C. The capital losses suffered by shareholders when they fail to foresee a fall in share prices.
 - D. The sacrifice of the next most desired alternative
8. When the marginal product is equal to average product,
 - A. Average product is rising
 - B. Marginal product is rising
 - C. Average product is at a maximum
 - D. Marginal product is at a maximum
9. The price elasticity of demand for a horizontal demand curve is:
 - A. Zero
 - B. One
 - C. Infinite
 - D. Positive
10. The long run supply curve for a constant cost competitive industry is:
 - A. Perfectly inelastic
 - B. Perfectly elastic
 - C. Negative
 - D. One
11. The monopolist maximizes total revenue when:
 - A. $MR = MC$ and $P > ATC$
 - B. Price elasticity of demand is -1
 - C. Demand is inelastic
 - D. Demand is elastic

Section B: Answer any four questions

(80 marks)

1. The tables below give details of the inputs and outputs of a particular firm over different time periods

Table A

Table B

No of workers' units	Capital units	Output units	No. of workers units	Capital units	Output units
1	1	100	1	1	100
2	1	150	2	2	240
3	1	190	3	3	400
4	1	220	4	4	550
5	1	240	5	5	700
6	1	250	6	6	850

- Which table shows changes in output in the short run? Explain.
 - Which table shows changes in output in the long run? Explain.
 - Which table illustrates the operation of the law of diminishing returns?
 - Which table provides illustration of economies of scale?
 - Portray the information contained in Table A and B graphically. Why is it not possible to do the same for the information in Table B? (20)
2. Explain what you understand by the following concepts:
- isoquant
 - production possibility curve
 - circular flow model
 - marginal rate of substitution
- 3.
- Draw a diagram showing the income and substitution effects of an inferior good.
 - Using indifference curve analysis, show how to derive a demand curve.
 - Show and explain with the aid of a diagram why indifference curves do not intersect or touch each other. (20)
4. This question is based on the following table which shows the cost and revenue relating to possible weekly outputs of a firm. The product is consumer good.

Output (000)	Total costs (K,000)	Total Revenue (K,000)
4	47	76
5	57	90
6	66	102
7	74	112
8	80	120
9	85	126
10	91	130
11	99	132
12	110	132

- Is this firm operating under perfect or imperfect competition?
- What is the most profitable weekly output?
- Suppose the costs and market demand remain as shown in the table, and the firm is a contract to supply Shoprite with 5000 units per week at a price of K15 per unit. Should the firm accept the contract? Explain. (20)

5. This question is based on the following unit cost data for a purely competitive firm:

Output level	Average fixed cost	Average variable cost	Marginal cost
1	60.00	45.00	45
2		42.50	40
3		40.00	35
4		37.50	30
5		37.00	35
6		37.50	40
7		38.57	45
8		40.63	55
9		43.33	65
10		46.60	75

- a. Compute the average fixed cost for each level of output
- b. Compute the average total cost for each level of output
- c. Compute the marginal revenue for each level of output if price is 65
- d. Can you maximize profits in this case? Explain.

(20)

6. Contrast the following with the aid of diagrams:

- a. Short run profit maximising conditions under monopoly from pure competition.
- b. Long run equilibrium conditions for monopoly from pure competition.
- c. Demand and marginal revenue curves of a monopoly from those of pure competition.
- d. Total revenue curve under pure monopoly from that of pure competition.

(20)

12. The price cut will decrease the amount of money a firm receives if the demand for its product:
- A. Relatively elastic
 - B. Relatively inelastic
 - C. Unit elastic
 - D. Has a flat slope
 - E. Both [A] and [B]

13. Which of the following statements is incorrect under perfect competition?
- A. The inelastic demand curve is downward sloping
 - B. The individual firm aims to produce where AC is at a minimum
 - C. A firm may earn abnormal profits in the short run
 - D. The firm can sell as much as it wishes at the ruling market price

14. The demand curve for a monopolist
- A. Is equal to the MC curve
 - B. Is equal to the MR curve
 - C. Is the same as the industry demand curve
 - D. Does not exist
 - E. Will always be below the MR curve at all levels of output

15. The most critical feature of the of oligopoly is:
- A. Mutual interdependence
 - B. Homogenous products
 - C. Advertising
 - D. Moderate barriers to entry
 - E. Low price elasticity

16. In a particular market, the short run supply curve is perfectly inelastic. If demand at all prices increases by 10 per cent, what happens to total revenue?

17. The following equation represents the market demand function for good A:

$$Q = 400 - 5P - 0.1Y$$

where Q is the quantity demanded per week in thousands of tonnes, P is the price of good A in Kwacha, and Y is the national income in billions of kwacha. Is good A:

- A. An inferior good?
- B. A normal good?
- C. A giffen good?

Explain:

18. The price elasticity of demand for a product is -1.5. To what extent will a fall of 10 per cent in price of the product affect the quantity demanded?

19. The U-shaped cost curves of the individual firm include normal profit. What is meant by normal profit?

20. This question is based on the following relationships between certain costs and revenues when firms are in equilibrium in different types of market.

- I. $AR = MR = AC = MC$
- II. $AR > MR; AR = AC; MR = MC$
- III. $AR > MR; AR > AC; MC = MR$

Which of these above conditions apply to:

- A. A firm in long run equilibrium under imperfect competition when there are no effective barriers to entry?
- B. A monopoly?
- C. A firm in long-run equilibrium under conditions of perfect competition?

UNIVERSITY OF ZAMBIA
DEPARTMENT OF AGRICULTURAL ECONOMICS

University Examinations - First Semester Examinations

May, 1999

AGE 411: Introduction to Agribusiness Management

Instructions: Answer five (5) questions **ONLY**: Questions 1 and 2 are compulsory. Each question carries twenty (20) marks. **Time: 3 hrs**

1. The following trial balance is drawn from various accounts for Sondoyi & Sons at the end December 1998.

	Dr	Cr
Sales		13400
Purchases	8520	
Lighting and Heating	380	
Rent	480	
Returns inwards	100	
Wages: shop assistant	1040	
General expenses	140	
Returns outwards		400
Carriage outwards	220	
Buildings	4000	
Fixtures and fittings	1500	
Debtors	2400	
Creditors		1800
Bank	240	
Cash	380	
Loan from W. Chipeta		2000
Drawings	1800	
Capital		4200
Stock (31.12.1997)	600	
	21800	21800

(Stock at 31.12.1998 was 1100)

- I) Prepare the Trading and Profit and Loss Account and Balance Sheet
- ii) Calculate and interpret the following:
- a. Current ratio
 - b. Solvency ratio
 - c. Days sales in receivables (appropriate period is 30 days)
 - d. Wage efficiency ratio
 - c. Profit on sales

2. During the production planning stage, a certain firm estimated its profit function as:

$$\pi = py - w_1^{0.5}w_2^{0.5}y - F$$

where π is the profit, p is the output price, y is the marketed output, w_1 and w_2 are input prices, and F are the fixed costs. Management intends to either expand, maintain or cut down production in the face of an uncertain market environment in the near future. Consultants project that if the market expands, then p will be 95; if it remains stable, p will be 80; and if there is a recession, p will be 50. Input prices will remain unchanged at 49 and 64 for w_1 and w_2 respectively. The normal output is 1000 but management wishes to increase by 50 per cent or reduce it by 50 per cent depending on the advice to be given. If it rises by 50 per cent, fixed costs will also rise from the normal 2000 to 10000 (if the recession occurs, fixed costs will remain at 2000 through a government subsidy).

- a. Summarise this information into a profit risk matrix.
 - b. Determine the appropriate management action under the Wald strategy?
 - c. Determine the appropriate management action under the Savage strategy?
 - d. Determine the appropriate management action under the Bayesian strategy?
3. An agrifirm produces and sells fresh tomatoes. Due to lack of transport, marketeers to the firm to buy tomatoes which they later sell at Lusaka's Old Soweto Market. The supply at the farm level is given by $Q=500+10P$. Demand at the farm level is $Q=5500-30P$, and the retail demand at Old Soweto Market is $P=250-Q/30$.
- a. Calculate the:
 - (I) equilibrium quantity and price at the farm level
 - (II) marketing margin
 - (III) price elasticities of demand at both farm and Old Soweto Market
 - b. Discuss factors that affect marketing spread in this case
 - c. Explain how vertical integration will affect marketing spread
4. An evaluation of various marketing outlets for a dairy firm in Lusaka shows the following costs due to perishability (figures are in '000):

Kamwala	K250
Chelston	K950
Woodlands	K975
Chawama	K150
Mutendere	K200
Bauleni	K175
Chunga	K350
Matero	K300
Lilanda	K250
Kabwata	K850

- a. **Separate the perishability costs using the Lorenz curves**
 - b. **Explain the 80/20 principle**
 - c. **Which outlets should the firm consider closing down?**
 - d. **How else may this problem be minimized?**
5. **Discuss how you would plan the production of tinned fish. The source of the fish is Lake Kariba and the major market for tinned fish is Lusaka.**
6. **Write short notes on:**
- a. **Functions of personnel management**
 - b. **Marketing functions**
 - c. **Single proprietorship**
 - d. **Features of agribusiness products**

THE UNIVERSITY OF ZAMBIA

FIRST SEMESTER FINAL EXAMINATIONS - MAY 1999

**AGE 531
INTERNATIONAL AGRICULTURAL TRADE**

TIME : 3 HOURS

INSTRUCTIONS: ANSWER ALL FIVE QUESTIONS

.....

1. (a) Explain briefly the free trade doctrine and its impacts on developing countries which trade in primary agricultural commodities mainly with developed countries.
- (b) Discuss the arguments brought forward in favour of a protectionist trade policy with special reference to developing countries.
2. Briefly discuss the following concepts:
 - (a) Four types of exchange rate regimes.
 - (b) Economic integration and its importance
 - (c) Exchange rate adjustment and its implications
 - (d) Absolute advantage and comparative advantage
3. Discuss the five major challenges faced by developing countries when participating in international trade. For each challenge suggest the corrective measures these countries should adopt in order to be successful in trade.
4. It is known that an import tariff and an import quota are alternative ways of achieving the same effect.

Prove this statement using partial equilibrium approach involving a large importing country in the trade of wheat. You are the trade policy analyst hired by the government of this large country to examine the effects of an import quota and a fixed import tariff.

Compare and contrast the welfare implications of the import tariff and import quota advice the government on which policy to follow.

UNIVERSITY OF ZAMBIA
FIRST SEMESTER EXAMINATIONS - MAY 1999
PROJECT PLANNING & APPRAISAL
AGE 541

TIME: 3 HOURS

INSTRUCTIONS: (i) ANSWER ALL QUESTIONS
(ii) LEAVE COMPOUNDING/DISCOUNTING TABLES IN THE EXAMINATION HALL

-
- Q1. a) Explain why economic analysis is carried out in project preparation. (4)
- b) Discuss the steps involved in the process of converting financial prices to economic values. Give formula(s), if any, that would be of help in each case. (12)
- c) How is the application of the SCF approach different from the SER approach in economic analysis. (4)
- Q2. a) What are the two major sources of financing public sector projects in Zambia? (2)
- b) Choose one of the two major sources of financing public sector projects in (a) above and discuss both its advantages and disadvantages. (4)
- c) Mukela Mwanalushi, a retrenchee, returns to Senanga with the intention of establishing a cashew plantation. He borrows ZK20 million from the Development Bank of Zambia at 20% interest rate. ZK8 million is disbursed in the first year, ZK7 million in the second year and ZK5 million in the third year. He is allowed a grace period of three years. Interest due during the grace period is capitalised.
- i) Calculate the amount of annual level payments needed to service the debt. (6)
- ii) Develop a debt repayment schedule (4)
- iii) Assuming inflation to be 5% compute the declining real burden of debt service (4)
-
- Q3. Chamuka Cooperative Society of Mwinilunga has serious intentions to invest in a pineapple canning plant. The project involves an investment outlay of K96,000,000 in year one. Other costs in the form of operation and maintenance as well as cash inflows are given in the table below:

Year	Investment Outlay	Operation Maintenance	Cash Inflows
1	96,000,000	3,200,000	27,200,000
2	-	3,200,000	31,200,000
3	-	4,000,000	36,000,000
4	-	4,000,000	32,000,000
5	-	4,800,000	32,000,000

- Calculate the payback period (4)
- Use the graphical methods to compute the internal rate of return (8)
- On the basis of your answers in a) and b) above and considering that the opportunity cost of capital is 15% would you recommend the processing plant as a good investment? Explain (4)
- What advantages do discounted measures of project worth have over undiscounted measures of project worth. (4)

- Q4.
- Define and depict the project cycle graphically. (2)
 - At what stage of the project cycle is a feasibility study carried out? Explain in detail why a feasibility study is carried out (6)
 - Discuss any four reasons why agricultural projects run into problems of implementation (12)

Q5. Define, distinguish and give examples of the following:

- Project versus Program (5)
- "With and without" comparisons versus "Before and After" Comparisons (5).
- Tangible benefits versus Intangible benefits (5)
- Traded good versus untraded good (5)

THE UNIVERSITY OF ZAMBIA

SUPPLEMENTARY/DEFERRED EXAMINATIONS: NOV/DEC. 1999

AGF211 GENERAL MICROBIOLOGY

THEORY PAPER

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS. ANSWERS MAY BE ENHANCED BY INCLUDING DIAGRAMS ALL QUESTIONS CARRY EQUAL MARKS

1. Define bacteria growth. Discuss bacteria growth in batch culture.
2. Describe the structure of viruses giving four general morphological types. State three ways in which a virus particle differ from living cells
3. Discuss the life cycle of a bread mould. State the important characteristics of fungal spores
4. Discuss conditions that influence the effectiveness of anti-microbial agent activity. Give two examples each of physical and chemical agents.
5. Comment briefly on all of the following:
 - a) Bacterial endospores
 - b) Col Plasmids
6. Discuss aerobic utilisation of glucose via the respiratory process. Illustrate your answer by giving overall reactions at each stage.

END OF EXAMINATION

School of Agriculture
University of Zambia

AGF 221 – COMPUTER SCIENCES DEFFERED EXAMINATION

Instructions:

Answer all questions

Duration: **2** hours

1. a) Write brief notes on the following

- i) CPU
- ii) VDU
- iii) RAM
- iv) CD-ROM
- v) POS
- vi) ASCII

(20 Marks)

b) Distinguish between a microcomputer and a mainframe computer

(10 Marks)

(Total 30 Marks)

2 What is the purpose of the following software

- a) C++ Compiler
- b) Norton Anti virus
- c) DOS 6.1
- d) Microsoft excel
- e) Word perfect

(Total 20 Marks)

3 Many organisations are now able to make use of information technology through the use of e-mail

- a) Define the terms
 - i) Information technology
 - ii) e-mail (4 Marks)

b) What hardware and software is necessary in order to install e-mail ? (10 Marks)

c) What are the advantages of using e-mail ? (6 Marks)

(Total 20 Marks)

4) In recent years, there has been a shift from C to C++

a) Distinguish between C and C++
(4 Marks)

b) Determine which of the following are valid C++ identifiers. If not, explain why?
i) #name ii) int iii) first1 iv) total salary v) tel.no-1
(10 Marks)

c) A C++ program contains the following declarations

```
int a=10, b=4, c=2, z;
```

Use the values initially assigned to the variables to find the value of z in the following expressions:

- i) $z = a/b;$
 - ii) $z = a\%b;$
 - iii) $z = ++a+b;$
 - iv) $z = a/b+c*2;$
 - v) $z = (a>2) \&\& (b<5);$
- (10 Marks)

d) Write an interactive C++ program to calculate the average of any two numbers entered from the keyboard. The program should display the result on the screen.
(6 Marks)

(Total 30 Marks)

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS

AGG 311 Probability and Statistics

December, 2000

INSTRUCTIONS

Answer **Question Number 1** and **any other four (4)**.

Points for each question are indicated in brackets

Q1. An experiment to investigate the effect of pasture on milk production uses a Latin Square design. Four different pastures (paddocks) A, B, C and D are used for feeding each cow. Each cow grazes in one paddock for three weeks and the milk yield is recorded in the third week. The reason for measuring milk yield only in the third week is to avoid any carry over of the effect of the last paddock. Analyse the data below (milk yield in litres) and test the hypothesis that the pastures are not different in their effect on milk yield.

Period	Cow				
		1	2	3	4
1		A=96.0	B=97.5	C=146.0	D=124.5
2		B=95.0	D=101.5	A=109.0	C=105.0
3		C=107.0	A=69.9	D=122.5	B=81.5
4		D=110.5	C=76.0	B=102	A=67.0

Q2. A student is carrying out a trial involving six sorghum varieties. He is worried that the pH of the trial site is not uniform. The pH test shows that there is no strong gradient in any direction, although the variation exists. Show how he can best carry out his experiment to achieve reproducible results to test the differences among the varieties.

Q3. In a study of the effect of penicillin on the survival of mice the following results were obtained:

Inoculum*	Alive	Dead
NA	10	30
FA	9	31
Paba	9	31
B ₆	13	27

* The inoculum was cultured on different media denoted NA, FA, Paba and B₆

- Q.4** (a) Define probability (5 points)
(b) What role does probability play in statistics (5 points)
(c) When should permutation and combination be used? (5 points)
(d) An experimenter must select three recipes of making ice cream from ten available as a control set. In how many ways can the control group be selected? (5 points)

Q.5 An animal scientist collects the following set of data on digestible protein (%) from an improved variety of alfalfa hay (early bloom) (20 points)

11.4	11.2	11	11.8	10
10.8	11.2	11.4	11.5	11.8
11	11.9	10.8	11.3	11.6

- (a) Determine the mean, mode and median of the data
(b) Compute the standard deviation
(c) Calculate the first quartile and the seventy ninth percentile.

Q.6. Write short notes on (2.5 points each):

1. An experiment
2. Venn diagram
3. Additive Law of Probability
4. Confidence intervals
5. Correlation
6. Coefficient of variation
7. Hypothesis
8. Bartlett's Test

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS OCTOBER, 1999

STATISTICS AGG 311

INSTRUCTION: Answer Question ONE and any other THREE questions. Points for each question are indicated in brackets.

TIME: 3 hours

Q. 1(a) Define and state when you would use correlation and regression, separately. Give formulae for each and show the relationship between the two. (10 points)

1(b) Given the following data on units (kg) of nitrogen applied per hectare and grain yield (fresh weight) of sweet potato in

~~TONS~~ kg/hectare

Units of nitrogen (kg/ha)	Yield (kg ^{TONS} /ha)
65	6.5
100	6.3
82	5.9
133	6.3
133	7.3
165	8.0
116	6.9
120	8.1
150	8.7
117	6.6

- (i) State the linear model applicable (3 points)
- (ii) Calculate the regression coefficient (5 points)
- (iii) Carry out the analysis of variance for testing the significance of the regression at $\alpha=0.05$. (15 points)
- (iv) Give a comprehensive interpretation of both (ii) and (iii) (5 points)

Q. 2 Write brief notes on the following (2 points each)

- (i) Measures of Central tendency
- (ii) Deductive and inductive reasoning
- (iii) Conditional probability
- (iv) Bartlett's Test
- (v) Blocking and replication
- (vi) Null hypothesis
- (vii) Randomization
- (viii) Coefficient of variation
- (ix) Additive and multiplicative laws
- (x) Statistics

Q. 3 A dealer who buys items in lots of 15 selects four items at random and inspects them thoroughly. He accepts all 15 if there are no defectives among the four inspected. Suppose that a lot contains three defective items.

(a) What is the probability that the dealer will nonetheless accept all fifteen? (10 points)

(b) What is the probability that he will find the three defectives? (10 points)

Q.4 From a herbicide screening trial the following data was obtained.

	B L O C K			
TREATMENT	1	2	3	4
2,4-D	2.05	1.56	1.68	1.69
Check	1.25	1.73	1.82	1.31
Ndine	1.95	2.00	1.83	1.81
Tiyeni	1.75	1.93	1.70	1.59

Carry out a FULL and COMPREHENSIVE analysis and interpretation (20 points)

Q.5 A company has been experimenting a new procedure of assembling a device it manufactures. the procedure is taught to nine (9) employees and the time taken to assemble the device is recorded for the nine (9) employees trained and then for the other nine (9) not trained. The following results were obtained:

Time in minutes to assemble the device

Standard Procedure	New Procedure
32	35
37	31
35	29
28	25
41	34
44	40
35	27
31	32
34	31

Do the results present sufficient evidence to indicate that the mean time to assemble the device is less for the new procedure? (20 points)

Q.6 Given the following data from a laboratory experiment

Factor A	1	2	3	1	2	3	1	2	3
Factor B									
20.0	3.0	3.4	2.9	2.8	3.1	3.1	3.1	3.5	3.2
22.5	3.5	4.1	2.6	3.2	3.6	3.0	3.7	4.0	3.4
25.0	3.7	3.8	3.3	4.0	4.2	3.2	4.1	3.9	3.9
27.5	3.6	4.2	3.6	4.1	4.0	4.0	4.0	4.4	4.5

- What design was used? (3 points)
- Summarise the data (5 points)
- Present a skeleton Analysis of variance table. (7 points)
- Give appropriate formula used to obtain the Sums of squares for each source of variation. (5 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

DEFERRED/SUPPLEMENTARY EXAMINATION- DECEMBER, 1999

AGG 311: STATISTICS AND EXPERIMENTAL DESIGNS

INSTRUCTIONS

Answer all questions. All questions carry equal points.

- Q1. Your first assignment as a Senior Agricultural Research Officer is to advise your Unit on proper statistical analysis of data obtained from field trials. You pick on a set of results from a maize yield trial given below in tons/ha:

MAIZE VARIETY	Block			
	1	2	3	4
MMV 400	9.3	9.4	9.6	10.0
MM 501	9.4	9.3	9.8	9.9
GV 412	9.2	9.4	9.5	9.7
Pool 16	9.7	9.6	10.0	10.2

Carry out a complete analysis and interpretation of the results: Remember you have to show your Unit how the analysis is done. **(25 points)**.

- Q2. (a) What experimental designs do you know? Give at least four. **(5 points)**
- (b) Explain how randomization is done of each of those and give the skeleton analysis of variance for each of them. **(10 points)**
- (c) Explain in detail when each one of these designs is most appropriate to use.
(10 points)

- Q3. (a) Apply the Lsd and Duncan multiple Range test (DMRT) on the following results of an analysis of variance:

Source of Variation	df	SS	MS
Treatments	5	847.05	169.41
Error	24	282.93	11.79
Total	29	1,129.98	

The means of the treatments were given as follows; 28.8, 24.0, 14.6, 19.6, 13.3 and 18.7

- b. Give a full interpretation of your results. Is there a difference between Lsd and DMRT.
(25 points)
- Q4. a. What is a quartile? Give example **(5 points)**
- b. Why do we need experimentation? Give an example of an experiment. **(5 points)**
- c. List the practical considerations you would have in carrying out field experimentation. Explain the effect/importance of each one of them. **(5 points)**
- d. How is regression related to correlation? Show this algebraically. **(5 points)**
- e. Give a practical situation where probability plays a role. Show how. **(5 points)**

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS

May 1999

AGS 211

FUNDAMENTALS OF SOIL SCIENCE

TIME : 3 HOURS
MARKS : 80 MARKS

Answer all questions and be precise. Candidates are requested, in their own interest, to write legibly

QUESTION 1

Discuss the basic structure of any five major silicate minerals from the simplest to the most complex, and give two examples of each type. [10 Marks]

QUESTION 2

- (a) Describe the general scheme by which calcite or other carbonate mineral dissolves in water containing dissolved CO_2 . [6 Marks]
- (b) Give brief accounts of podzolization and laterization, and explain the distinguishing features between them. [10 Marks]

QUESTION 3

- (a) Discuss the direct effects of climate on the physical and chemical properties of the soil profile. [10 Marks]
- (b) Describe Zambian examples of situations in which the following might be the dominant soil forming factors:
- (i) Climate
 - (ii) Parent material and
 - (iii) Topography [6 Marks]

QUESTION 4

- (a) Assume that an equidimensional cuboid sand grain is subdivided into smaller cubes of silt and clay size particles. Calculate the resulting total specific surface area of each particle size fraction. [6 Marks]
- (b) List the major soil colloids, and describe their specific properties which make them the most important determinants of soil properties. [7]
- (c) How can a soil be more porous and yet be less permeable? [2 Marks]
- (d) Why can clay compact more than sand? [2 Marks]

QUESTION 5

A soil to a depth of 30 cm has a C/N ratio of 15:1, a bulk density of 1.35 g/cm^3 and an average total N content of 0.16%.

- (a) Calculate the total organic matter content in this layer of soil. [4 Marks]
- (b) Given that soil organic matter decomposes by first order kinetics or exponential decay, calculate the time it will take for one half the amount of organic matter to decompose ($t_{1/2}$). Assume the decomposition rate is 0.186 per week. [6 Marks]

QUESTION 6

- (a) A soil holds 43% moisture at Field Capacity (FC-mass basis). If only 15% moisture depletion is allowed in the top 15 cm of the soil before the soil must be irrigated, calculate the depth of irrigation water that must be applied in order to bring the soil back to FC. The soil has a bulk density of 1.43 g/cm^3 . [4 Marks]
- (b) How is water retained in soil, and what soil properties determine water retention capacity? [7 Marks]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS

May 1999

AGS 411

SOIL FERTILITY

TIME : 3 HOURS
MARKS : 70 MARKS

Answer all questions. Be precise.

QUESTION 1

What are the criteria for selecting essential elements for crop production?

[Marks 6]

QUESTION 2

(a) What is reversibility of cation exchange? Give two conditions (reactions) when reversibility is not possible.

[Marks 4]

(c) What is meant by adsorbed

(i) ions and

(ii) exchangeable ions?

[Marks 4]

QUESTION 3

(a) Discuss the differences between NH_4^+ and NO_3^- ions in terms of application to the soil, plant uptake and utilisation.

[Marks 10]

(b) Discuss the different factors that affect S availability in Zambian soils.

[Marks 5]

- (c) Given the following information, calculate the nitrogen mineralised per hectare in one year. Total soil N is 0.15%, mineralisation rate is 3% per year, bulk density of top soil 20cm is 1.4gcm^{-3} . [Marks 5]

QUESTION 4

Discuss the use of chelates in the supply of Fe and Mn to alleviate the deficiency of these micronutrients. [Marks 5]

QUESTION 5

- (a) Explain the importance of soil pH in relation to P availability to plants. Mention the different P ions in existence at different pH levels. [Marks 5]
- (b) Give the different forms in which P exists in the soil apart from the phosphorus in living organisms. [Marks 4]
- (c) Explain clearly how you may produce orthophosphoric acid and superphosphoric acids from apatite, giving the reaction equations. [Marks 5]

QUESTION 6

Discuss in detail the different phosphorus management strategies that you may recommend to a farmer. [Marks 10]

QUESTION 7

- (a) How does irrigation contribute to salinity and how would you alleviate the salinity problem? [Marks 4]
- (b) What is the effect of salinity on plant growth? [Marks 6]
- (c) What is the effect of sodicity on soils? [Marks 5]

QUESTION 8

What are the main reasons for the differences between soils of Northern Zambia and those of Southern Zambia? [Marks 2]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS

May 1999

AGS 431

SOIL MINERALOGY AND MICROMORPHOLOGY

TIME : 3 HOURS
MARKS : 100 MARKS

Answer all questions. Be precise.

QUESTION 1

The criteria used in classification of rocks are origin, grain size and mineral composition. By the use of these criteria three groups of rocks are universally recognised,

- (a) What are these groups of rocks?
- (b) How are these groups of rocks formed?
- (c) Give examples of each of the classes of rocks.

[Marks 12]

QUESTION 2

Define and discuss the following chemical changes

- (a) Ferralitisation
- (b) Siallitisation
- (c) Simatisation
- (d) Fersialitisation

[Marks 16]

QUESTION 3

- (a) What are silica minerals?
- (b) Describe the characteristics of silica minerals
- (c) How do some of these characteristics affect the soils in which silica minerals are a dominant fraction

[Marks 15]

QUESTION 4

- (a) Describe the kaolinite group of clay minerals [Marks 3]
- (b) Discuss the characteristics of kaolinite and how these characteristics affect the soils in which kaolinite is dominant [Marks 5]

QUESTION 5

- (a) How does Differential Thermal Analysis (DTA) work as a mineral identification method? [Marks 5]
- (b) How are DTA qualitative and quantitative analysis (and interpretation) carried out? [Marks 4]

QUESTION 6

The mineral apatite belongs to the hexagonal crystal system. Work done by the International Fertiliser Development Center (IFDC) in the USA, on rock phosphate from Chilembwe revealed that apatite crystals in these rocks had the following crystallographic unit cell dimensions;

$$a=9.410 \text{ \AA}, c=6.882 \text{ \AA}$$

- (a) What is the axial ratio of this crystal? [Marks 2]
- (b) Is this crystal a uniaxial or biaxial mineral? (give reasons to support your answer) [Marks 3]
- (c) According to Soil Taxonomy is apatite a weatherable mineral or not? [2]
- (d) If a section of the crystal described above were cut perpendicular to its C-axis and mounted on a slide. What would you observe under crossed polarised light if you viewed this section and rotated it through an angle of 360 degrees. Give reasons to justify your answer. [Marks 3]

QUESTION 7

An isotropic mineral has a refractive index of 3.0

- (a) If the angle of incidence of light ray entering the mineral is 45 degrees, what is the angle of refraction of the light ray in the mineral? [Marks 2]
- (d) If the speed of light in air is assumed to be 3×10^8 m/s, what is the speed of light in this mineral? [Marks 2]

- (e) How would fragment of this mineral appear under crossed polarised light when rotated through 360 degrees (Give reasons to justify your answer) [Marks 3]

QUESTION 8

- (b) Define the following terms:

- (i) Parallel extinction
- (ii) Polarised light
- (iii) Pedofeature
- (iv) Argillan
- (v) Pleochroism

[Marks 10]

- (b) List some of the applications of the study of heavy minerals to Soil Science?

[Marks 5]

QUESTION 9

An analysis of the mineralogy of a soil from the Islands of the Bangweulu swamps revealed the following:

- i) Kaolinite was the only mineral in the clay fraction
- ii) The silt fraction contained only quartz
- iii) The sand fraction contained: 80% quartz, 5% tourmaline, 6% kyanite, 5% zircon and 4% rutile

- a) What can you infer about the inherent fertility potential of this soil? [Marks 3]

- b) How many grains would you need to count to obtain a reliable estimate of tourmaline at a 50% level of confidence and an allowable error of 10%. [Marks 5]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS

May 1999

AGS 531

LAND EVALUATION AND IMPROVEMENT

TIME : 3 HOURS
MARKS : 100 MARKS

Answer all questions. Be precise.

QUESTION 1

A commercial farm in Chisamba has been under annual cropping with high inputs and mechanisation since 1969. The yields have since declined to about 50% of what they were in the first five years and the farmer is now barely breaking even on his seasonal investments.

- (a) Explain in detail the likely causes of this decline in productivity. [Marks 6]
- (b) What management practices should the farmer have adopted from the very outset to avoid the constraints identified in (a) above. [Marks 5]
- (c) Prescribe a specific recommendation package to alleviate the constraints and return productivity of the farm to profitability. [Marks 2]

QUESTION 2

A 10 gram soil sample from an acid Lilayi farm contains the following ions in the final volume (50 cm³) of the solution extract :

$$\text{Al} = 32.40 \text{ mgdm}^{-3}$$

$$\text{Ca} = 39.20 \text{ mgdm}^{-3}$$

$$\text{Mg} = 9.84 \text{ mgdm}^{-3}$$

$$\text{K} = 102.2 \text{ mgdm}^{-3}$$

- (a) Calculate the ECEC of the soil. [Marks 10]
- (b) Calculate the Al saturation of the soil. [Marks 2]
- (c) If it is desired to grow groundnuts (maximum tolerance to Al of 15% Al saturation), calculate the lime requirement of the soil, given that the agricultural lime on the market has a neutralising value of 65%. [Marks 5]
- (d) Describe the factors that may affect the reactivity of lime in the soil. [Marks 3]

QUESTION 3

A land evaluation unit on a farm in region II of Zambia has been found to be currently unsuitable for wheat production due to a severe limitation in nutrient retention. Prescribe in detail two (2) alternative options for consideration by the farmer. [Marks 10]

QUESTION 4

Suggest a methodology for determination of water availability in the assessment of the suitability of land to soybean production. [Marks 10]

QUESTION 5

- (a) What are the land qualities that would be important in assessing the suitability of land for beef production. Justify your choice of each one of them. [Marks 5]
- (b) A farm in region III of Zambia has seemingly very good natural grazing for beef and dairy production but experiencing very low productivity. Discuss the likely causes of this. [Marks 5]

QUESTION 6

Past efforts to control soil erosion have largely been unsuccessful. Discuss why it is so and suggest alternative approaches more likely to succeed. [Marks 15]

QUESTION 7

An investor is proposing to build a multi-million kwacha hotel and golf course at the source of the Chalimbana river. Discuss the likely consequences of this development and how they would be caused. [Marks 10]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS

MAY 1999
AGS 551

**PLANNING AND DEVELOPMENT OF IRRIGATION
AND DRAINAGE SYSTEMS**

TIME: 3 Hours

MARKS: 100

ANSWER ALL QUESTIONS AND BE PRECISE

QUESTION 1

- (a) Why is the knowledge of irrigation agronomy essential for successful irrigation?
- (b) Why is the knowledge of the movement of water into the soil important and how can it be estimated empirically?
- (c) Discuss the four methods used to calculate potential evapotranspiration.
- (d) Given a crop water use of 5 mm/day, a soil with field capacity of 40 cm³/100cm³ and a wilting point of 15 cm³/100 cm³, safe depletion of 40% of the available water in the 1 metre root zone. When sprinkler laterals are set 18 m apart and 18 m spacing is used between the sprinklers on each lateral and application efficiency is 75%. Calculate:
 - i) amount of depletion allowed in mm.
 - ii) irrigation interval in days.
 - iii) depth of each irrigation.

QUESTION 2

- (a) Net irrigation requirement estimation account for which variables?
- (b) What factors affect crop water requirement?
- (c) What are the salt inputs and outputs considered in a salt balance equation?
- (d) What is leaching requirement?

- (e) A crop with $ET_{crop} = 1200$ mm irrigated on land of medium textured soil with $E_{Ce} = 7.7$ mmhos/cm and with a leaching efficiency ($LE = 0.7$) with $EC_w = 5$ mmhos/cm and by surface method. The effective rainfall during the season is 100 mm. Calculate:
- leaching requirement – (LR).
 - depth of water required to meet seasonal ET_{crop} .
 - depth of water required to meet LR.

QUESTION 3

- Describe the basic components of a sprinkler system.
- What considerations can you take into account when selecting a pump for irrigation?
- Discuss what constitutes an operating pressure at the end of a sprinkler lateral and what are the design considerations for a sprinkler lateral.
- Describe the main components of a trickle irrigation system and its disadvantages to smallscale farmers.
- Determine the required capacity of a sprinkler system to apply water at the rate of 1.25 cm/hr. Two 186 m long sprinkler lines are required and sixteen (16) sprinklers are spaced at 12 metres intervals on each line. The spacing between lines is 18 metres.

QUESTION 4

- What are the main components of a drainage system?
- Discuss the factors considered in design of drainage system.
- Describe mole drainage and what basic criteria for design can be used.
- Describe the characteristics of a tile drain.
- If given that a reservoir is the only source of ground flow in a 450 cm depth of water logged sand, what spacing of drains will draw, from the soil on both sides of a drain, a stream (Q) of $30,000\text{cm}^3/\text{s}$ in 75,000 cm length of a 450 cm depth drain in which water is 60 cm depth, when the water table is 150 cm below ground mid-way between the drains (N.B. Average permeability measured in the field soils in this case was $6.0 \times 10^{-2}\text{m/s}$).

QUESTION 5

- (a) Discuss and comment on the importance of the information needed for planning irrigation projects.
- (b) Discuss the specific irrigation objectives in Zambia and on what is the government directing its strategies to achieve them.
- (c) Define water duty and describe an irrigation canal command.
- (d) Discuss the characteristics which dictate the layout of a surface irrigation system.
- (e) Describe the design considerations for surface canal system.

END OF EXAMINATION