THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2009 FIST SEMESTER EXAM PAPERS

1. AGA 211   ANATOMY OF DOMESTIC ANIMAL
2. AGA 311   PRINCIPLES OF NUTRITION
3. AGA 351   ANIMAL PRODUCTION FOR ENGINEERS
4. AGA 511   TECHNIQUES IN ANIMAL SCIENCE
5. AGC 211   PRINCIPLES OF CROP PRODUCTION
6. AGC 411   FIELD CROP PRODUCTION
7. AGC 531   PRINCIPLES OF WEED MANAGEMENT
8. AGE 211   FUNDMENTALS OF MICRO-ECONOMICS
9. AGE 411   INTRODUCTION TO AGRIBUSINESS MANAGEMENT
10. AGE 511   AGRICULTURAL ORGANISATION AND ADMINISTRATION
11. AGE 521   INTRODUCTION TO FARM MANGEMENT
12. AGE 531   INTERNATIONAL AGRIC.MARKETS,TRADE AND DEVELOPMENT
13. AGE 541   AGRICULTURAL PROJECT PLANNING AND APPRAISAL
14. AGF 411   UNIT OPERATIONS IN FOOD ENGINEERING 1
15. AGF 421   FOOD TECHNOLOGY (PAPER 1-THEORY)
16. AGF 421   FOOD TECHNOLOGY(PAPER 2-PRACTICAL)
17. AGF 511   UNIT OPERATIONS IN FOOD ENGINEERING 2
18. AGF 521   PRINCIPLES OF FOOD TECHNOLOGY 2
19. AGG 311   EXPERIMENTAL DESIGNS AND STATISTICS
20. AGG 521   ADVANCED PLANT BREEDING
21. AGS 211   FUNDAMENTALS OF SOCIAL SCIENCES 1
22. AGS 311   AGROCLIMATOLOGY
23. AGS 411   SOIL FERTILITY
24. AGS 431   SOIL MINERALOGY AND MICRO MORPHOLOGY
25. AGS 441   AGRICULTURAL HYDRAULICS AND HYDROLOGY
26. AGS 531   LAND EVALUATION AND IMPROVEMENT
27. AGS 511   SOIL CHEMISTRY
28. EA 421   FUNDAMENTAL OF FARM STRUCTURES

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

ANATOMY OF DOMESTIC ANIMALS
AGA 211 FINAL EXAMINATION

First Semester 2009

INSTRUCTIONS:
1) ANSWER **ALL** QUESTIONS IN **BOTH** SECTIONS.
2) WRITE EACH SECTION IN SEPARATE BOOKLETS

SECTION ONE

QUESTION 1 (18 marks)

Zambia has indigenous and exotic species of animals.
   a) What do the terms indigenous and exotic mean?
   b) Name 3 indigenous breeds of cattle and 2 exotic breeds of cattle in Zambia.
   c) Is livestock necessary for Zambia? Give reasons for your answer?
   d) What are the types of livestock that are kept in Zambia?

QUESTION 2 (18 marks)

Define anatomy and explain how it is studied? What do the following terms mean in anatomy?

a) Anterior	(d) Dorsal	(g) Distal
b) Caudal	(e) Ventral	
c) Lateral	(f) Proximal	

QUESTION 3 (30 marks)

Write short notes on the anatomy of any five (5) of the following. You can use sketches if you so wish.

a) The respiratory zone of the respiratory system
b) Portal System naming two examples
c) Respiratory muscles
d) Anatomical differences between bone and cartilage
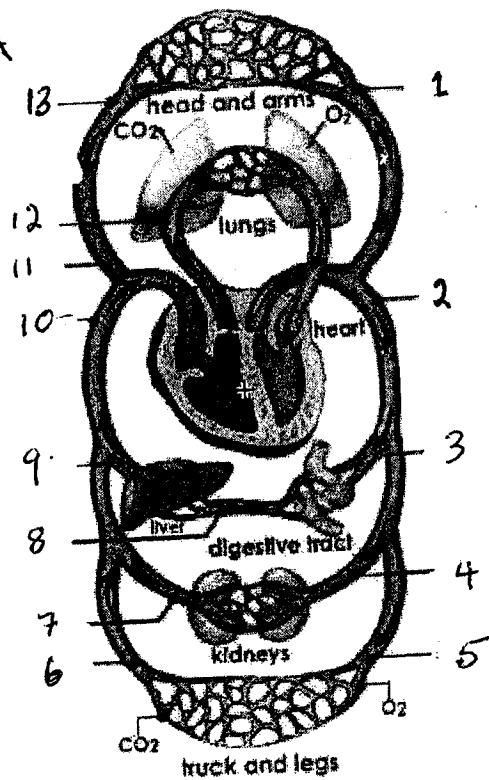e) The lungs
f) The plasma membrane

QUESTION 4 (6 marks)

What do you understand by the term epithelia? Name two types of epithelia, where they are found and their function?

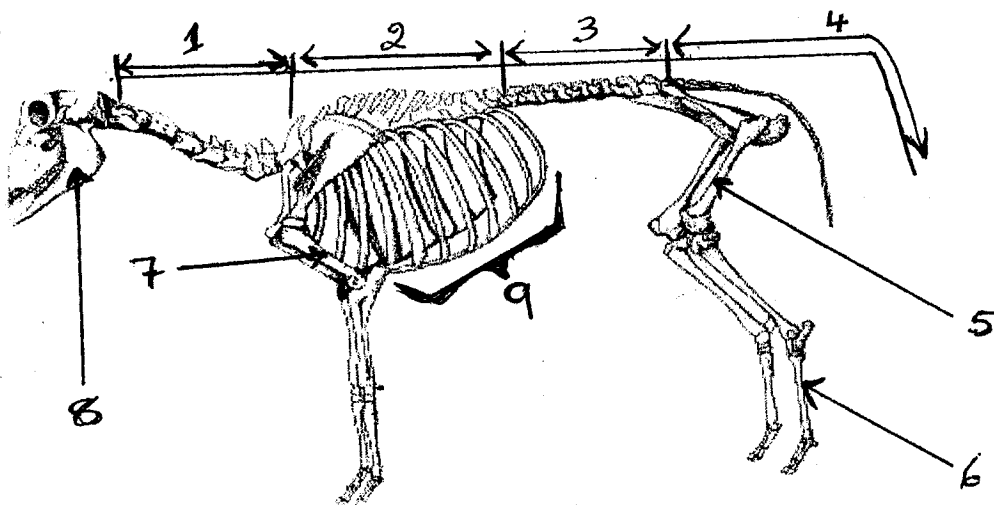## QUESTION 5 (28 marks)

You are provided with drawings on a separate sheet for identification. Identify the specimen given and label the numbers provided. Write your answers in your answer script identifying which section you are answering clearly.
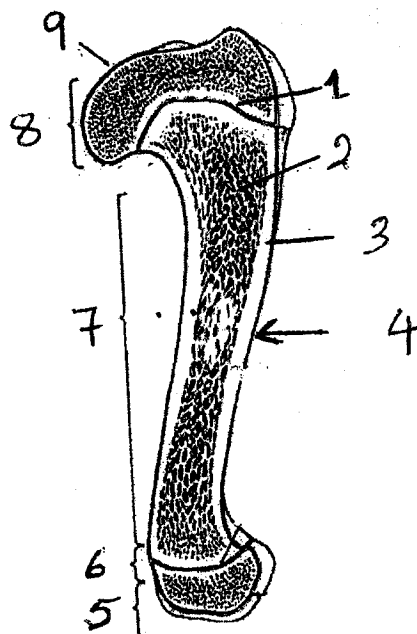
5 A

head and arms

13
CO_2
O_2
1

12
lungs

11

10
heart

2

9
liver

3

8
digestive tract

7
kidneys

4

6
5

CO_2
O_2

truck and legs

5 B.

1 2 3 4

7

9

8

5

6

5 C.

9

8

1

2

3

7

4

6

5

SECTION TWO

QUESTION 1 (30 marks)

The following diagram shows the general plan of the mammalian brain.

(a) Label the regions designated **A, B, C, D, E, F**
(b) Label the **1**st, **2**nd, **3**rd and **4**th ventricles
(c) In which region do we find the cranial nerves **V, VI, ...XII**?
(d) What is the name of cranial nerve **X**?
(e) Is this nerve in (d) above sensory, motor, or mixed? Explain briefly.

QUESTION 2 (30 marks)

(a) Draw a bovine pituitary gland, showing the following anatomical features:
  - Anterior pituitary
  - Posterior pituitary
  - Hypothalamic nuclei
  - Hypothalamic-neurohypophyseal tract
  - Hypophyseal artery
  - Hypothalamic-hypophyseal portal veins

(b) Mention the lobes of the anterior pituitary gland
(c) Where are the hypothalamic nuclei derived from?
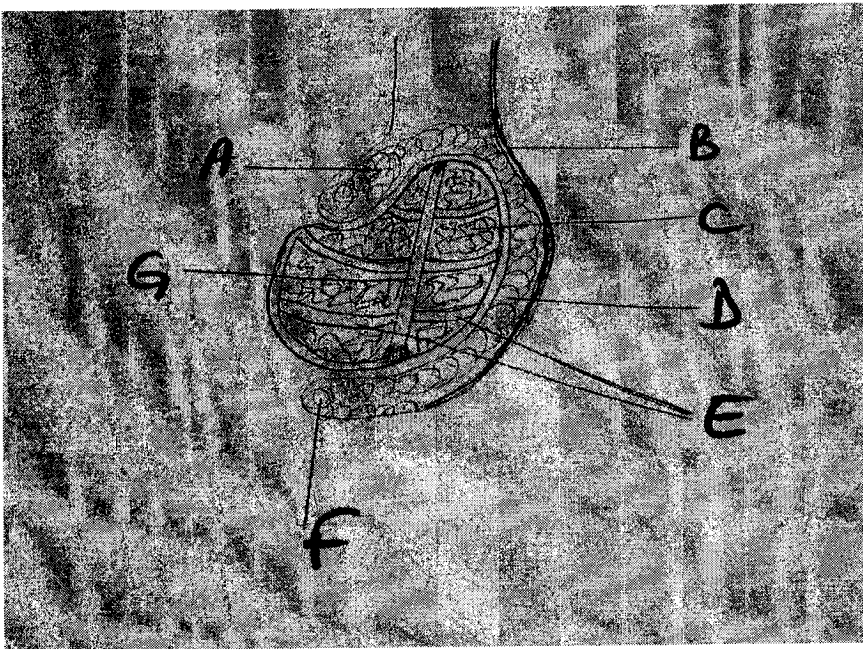
QUESTION 3 (20 marks)

(a) Draw a non-ruminant stomach, showing the following anatomical features:

3

- Cardia
- Pylorus
- Fundus
- Antrum
- Cardiac gland region
- Fundic gland region
- Pyloric gland region
- Esophageal region

(b) Describe the type of glands found in the fundic gland region.

QUESTION 4 (20 marks)
(a) Identify the structure below and label **A** through **G**.

(b) Describe the morphology of **C** in (a) above.

END OF EXAMINATION

THANK YOU FOR BEING WITH US IN THE COURSE. WE WISH YOU GOOD LUCK

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2009 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

COURSE AGA 311: **PRINCIPLES OF NUTRITION**

TIME ALLOWED: **THREE (3) HOURS**
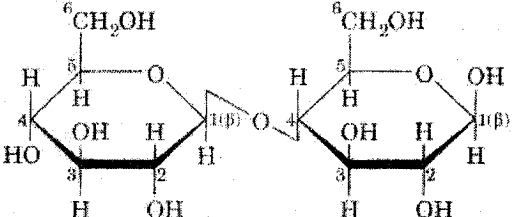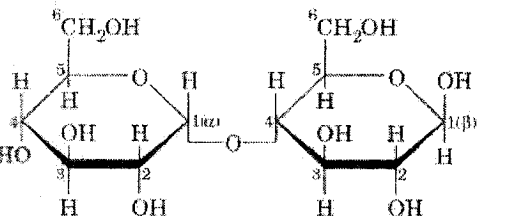
INSTRUCTIONS TO CANDIDATES:

i. Answer all questions in Sections A and C and one question in Section B.
ii. Write the answers for each Section in a separate answer book.

SECTION A: Nutrients and Non- ruminant Digestion, Absorption and Metabolism

Question 1 (20 marks)

A) Give the name, two functions in the animal body and one dietary source for each of the nutrients or components of nutrients whose structures are presented below:

B)
    a. List 3 (three) functions of Vitamin A in animal metabolism
    b. Describe the vitamin E deficiency signs in poultry.
    c. For any 3 (three) of the B Complex Vitamins indicate the following:
        i. The names of the different forms of each vitamin.
        ii. The names of the coenzymes in which the vitamins occur in metabolism.
        iii. The type of reaction mediated by the respective coenzymes.
        iv. One deficiency sign of each vitamin.

    d. Give one function in animal metabolism and one dietary source for any 3 (three) macro minerals and 3 (three) microminerals.
    e. List the different components of food or feed that are analyzed in the laboratory in the 'Proximate Analysis' procedure.

Question 2 (20 marks)

A)   Glucose is the central molecule in carbohydrate metabolism. Other hexoses that are metabolized for energy in the animal body include fructose, galactose, and mannose.

    a. Name one dietary source for each of the hexoses mentioned above.
    b. Explain how each of the hexoses mentioned is absorbed in the gastrointestinal tract.
    c. Fructose, galactose, and mannose are converted after absorption into metabolites that are incorporated into the glycolytic pathway for energy production or glycogen synthesis. With the aid of flow charts explain how any one of the hexoses: fructose, galactose, or mannose, are converted into glycolytic pathway metabolites.

B)   During glycolysis the conversion of Glyceraldehyde 3-phosphate to 1,3-Biphosphoglycerate is accompanied by the reduction of Nicotinamide Adenine Dinucleotide (NAD) as in the reaction below:

Glyceraldehyde 3-phosphate + NAD^+ + Pi $\longleftrightarrow$ 1,3-Biphosphoglycerate + NADH + H^+
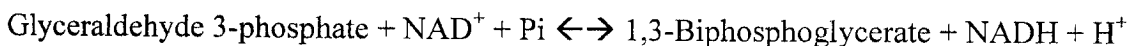
Briefly explain how the reduced Nicotinamide Adenine Dinucleotide (NADH + H^+) is oxidized to regenerate NAD^+ under aerobic glycolysis and under anaerobic glycolysis, respectively.

Question 3 (20 marks)

A)
    a. With the aid of flow diagrams outline *de-novo* synthesis of fatty acids in the animal body.
    b. Name the essential fatty acids.
    c. Explain why essential fatty acids **cannot be synthesized** by mammals and therefore, have to be provided in the diet.
    d. Give three (3) essential fatty acid deficiency symptoms in farm animals.

B)

   a. Complete the table below for **protein digestion enzymes** in the **non-ruminant** digestive tract and the peptide bonds they attack.

Organ	Protein digestion enzymes secreted	Types of **Peptide Bonds** attacked by specific enzymes
Mouth		
Stomach		
Duodenum		
Jejunum		
Ileum		
Colon		

   b. Outline the Urea Cycle.

SECTION B: Ruminant Digestion

SELECT ONLY ONE QUESTION FROM THIS SECTION

Question 1 (20 marks)

What are the main sources of carbohydrates for ruminants? How are these carbohydrates digested and how are their products utilized as a source of energy in the animal?

Question 2 (20 marks)

What are the advantages and disadvantages of rumen microbial fermentation in the utilization of various animal feed resources? How does the animal benefit from rumen microbial fermentation?

SECTION C: Feed Evaluation

Question 1: (10 marks)

A)   As a manager of a large cattle ranch, you want to know the digestibility of the hay in the new ranch you just bought. The following methods are available to you:
   1. Indicator method
   2. In-vitro enzyme digestibility method
   3. In sacco method

   For any two above answer the following for each method:

a. What is the principle on which each method is based?
b. What are the advantages?
c. What are the disadvantages?

B)   In a flow chart compare and contrast the Comparative Slaughter and Kellner's Energy Evaluation systems and give one disadvantage and advantage for each.

Question 2: (10 marks)

A)   The following data were collected from a 24 hour Carbon and Nitrogen trial of sheep.

Item	Carbon (g)	Nitrogen(g)	Energy in kcal
Intake in feed	600	42	6000
Fecal excretion	265	12	2000
Urine	30	20	300
Methane excretion	20	---	300
Carbon dioxide	230	....	....
Balance	?	?	?

Calculate:
a. Carbon and Nitrogen balance
b. Metabolizable energy balance
c. Energy stored as protein
d. Energy stored as fat
e. What is Net Energy gained?
Given:
Carbon in body protein is 0.512
Fat contains 0.746

B) What are the major factors that regulate feed intake in the ruminant animal?

4

THE UNIVERSITY OF ZAMBIA

THE SCHOOL OF AGRICULTURAL SCIENCES

2009 ACADEMIC YEAR – FIRST SEMESTER FINAL EXAMINATIONS

COURSE AGA 351 – ANIMAL PRODUCTION FOR ENGINEERS

TIME ALLOWED: THREE (3) HOURS ONLY

INSTRUCTIONS TO CANDIDATES:

a. Answer each Section in separate answer books.
b. Answer any five questions.

SECTION A (ANATOMY AND PHYSIOLOGY):

Q. 1 Discuss the anatomical and functional differences between male mammalian reproductive systems and male avian reproductive systems.

Q. 2 Write short notes on the following:
a. Cotton seed meal as a feed ingredient in laying hen diets
b. Advantages of a ruminant stomach over that of a non-ruminant
c. The process of physical breakdown of food in a chicken
d. Urea as a feed ingredient

Q. 3 Discuss the process of dietary protein utilization in a ruminant through digestion and absorption.

SECTION B (ANIMAL PRODUCTION):

Q. 4 Discuss the characteristics of the *Bos Indicus* cattle that make them more suitable to rear in Zambia. List down the *Bos indicus* breeds of cattle found in Zambia.

Q. 5 The Summer Breeding Season is sometimes referred to as the "Natural Breeding Season". Give reasons as to why it is so referred to. Discuss the advantages and disadvantages of the use of the Summer Breeding Season.

or

Discuss the beef routine management practices that should be implemented on a ranch in order for improved production.

Q. 6   What do you understand by the term "Clean Milk production"? Discuss the possible sources of milk contamination on a dairy farm of your choice.

or

It is good management to identify and cull the unproductive birds (non-layers) amongst the layers. Discuss how you could possibly identify a good laying bird amongst the layers and design an egg production record card to be used on a poultry farm of your choice.

End of Examination

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS –
NOVEMBER 2009
AGA 511 – TECHNIQUES IN ANIMAL SCIENCE

TIME: **3 HOURS**

INSTRUCTIONS: ANSWER FIVE (5) QUESTIONS. ANSWER AT LEAST ONE (1) QUESTION FROM EACH SECTION. QUESTIONS FROM EACH SECTION SHOULD BE ANSWERED IN SEPARATE ANSWER BOOKS.

SECTION 1: Project planning and proposal writing

1. A group of fellow graduates come to you for help to respond to an advert by a development non-governmental organization (NGO) that is empowering university graduates to start small scale projects in order to be self employed. The group did not take the Project planning and proposal writing part of AGA511.

   a. With the help of a flow chart show them the components of project planning and proposal writing
   b. Contrast Project planning from proposal writing
   c. What are the pillars of project implementation?
   d. Where does the business plan belong and for what purpose is it required?
   e. Briefly explain the importance of four (4) of the following terms:
      i. Literature review
      ii. Problem statement
      iii. Research Hypothesis
      iv. The research question
      v. The feasibility plan

SECTION 2: Enterprise Development, Feed Standards and Regulations, Feed Sampling & Sample Preparation

2. a. As an employee at a national laboratory you are sent by your supervisor to follow-up a complaint concerning a feed miller who is selling mouldy feed. You are required to go and collect a sample from the feed milling premises to verify whether the complaint is genuine or not.
      i. What sampling plan will you utilize to ensure proof of the presence of mouldy feed? Give reasons for selecting the particular sampling plan.
      ii. Explain, giving reasons, how you are going to store the sample to avoid changes which may affect results of analysis.
   b. Define feeding standards and write on the considerations made in applying feeding standards for growth.

c. Imagine that you have been given a contract to develop a 20,000 broiler enterprise by a Non-Governmental Organization (NGO) to raise funds for a community of vulnerable people.

    i. What stages do you expect to take the enterprise through toward its establishment?

    ii. Summarize the activities that are expected to take place at each stage.

SECTION 3: Experimental Design, Data Collection, Analysis & interpretation

3. a. Briefly define an experiment. Discuss three error control measures employed in scientific experimentation.

    b. What is the purpose of replication? State the factors that determine the number of replicates to use in an experiment.

    c. i) What is the purpose of a research protocol?

       ii) What constitutes meta-data?

4. In the animal feed manufacturing process, the efficiency of mixing feed ingredients which are included in small quantities such as vitamin supplements is very important. The mixer is supposed to do a thorough mixing so that all the feed has the same composition of these ingredients.

A study was instituted to investigate the vitamin mixing efficiency at a fixed mixer speed for four different types of vitamin supplements; A, B, C, and D. Four mixers were employed in the experiment and each vitamin supplement was tested in each of the mixers. The tests, one vitamin supplement per mixer, were conducted on four different days. Suggest the appropriate Design for this study, how would you measure the efficiency of mixing? Also present the form of the ANOVA table.

SECTION 4: Techniques in Animal Research & Animal Draft Power

5. One way of assessing nutritive value of animal feeds is by analyzing for chemical composition and nutrient digestibility. What are the advantages and disadvantages of using nylon bags and fistulated animals?

6. Body condition scoring is useful in monitoring the extent to which cattle are affected by nutrition, disease, work and other environmental factors. Body Condition Scoring is a subjective assessment.

    a) Give reasons why you would personally prefer to use body condition scores instead of physically measuring weight changes in beef cattle?

    b) What would be the body condition scores of beef cattle in Figures 1, 2, 3 and 4? What are the factors that you took into consideration to arrive at the body condition scores?

    c) What are the main sources of energy for work in draft animals and how are they utilized by animals in different body conditions during and after work?

END OF EXAMINATION

The University of Zambia

School of Agricultural Sciences
Department of Crop Science
Second Year Examinations for the Bachelor of Agricultural Sciences
AGC 211: Principles of Crop Production
First Semester 2009

Date: 4 November, 2009   Time: 09.00 – 12.00hrs

Instructions:
(1) Answer all Questions
(2) Marks as indicated

QUESTION 1 (15 MARKS)
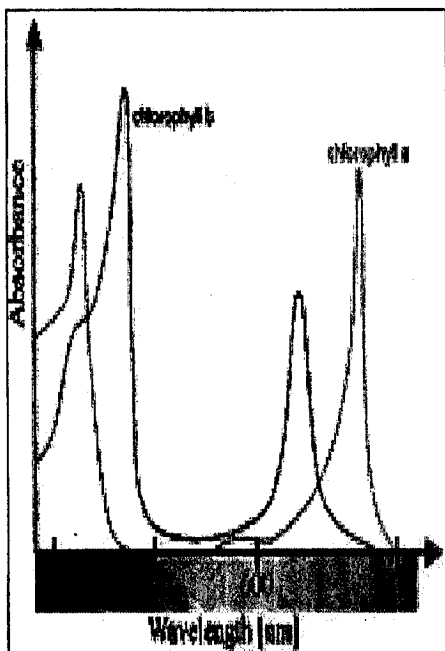
Figure 1. Effect of wavelength on absorbance in photosynthesis

a) Molybdenum is an important component of 2 major enzyme systems, what are these? (3 Marks)
b) What are the factors limiting crop production in the small-holder farming sector? (3 Marks)
c) Two sweet sorghum varieties Sima and Madhura were planted at the Field Station of the University of Zambia on 10th August 2009. Some plants from the variety Sima have started to flower while none of the plants in Madhura has flowered. Explain the underlying phenomena. (3 Marks)
d) Explain the significance of the wavelength of light on absorbance by chlorophyll in photosynthesis as depicted in Figure 1. (3 Marks)
e) Describe the 3 phytohormones responsible for senescence in plants. (3 Marks)

QUESTION 2 (25 MARKS)

A

i) What is "reference evapotranspiration"? **(3 Marks)**

ii) Name the method that provides a measurement of the integrated effect of radiation, wind, temperature and humidity on evaporation from an open water surface. Why is this method appropriate for measurement of reference evapotranspiration? **(7 Marks)**

iii) What are the advantages and disadvantages of the method? **(5 Marks)**

B

The soil water storage of a field was measured 61 days after planting using a neutron scattering method and is given in Table 1. Given that the runoff was insignificant, calculate the change of soil water storage and evapotranspiration after 61 days. **(10 Marks)**

Table 1: Soil water storage of a field

DAP	3	10	17	24	31	40	46	54	61
S*	18.4	20.0	20.9	20.1	24.7	18.4	20.8	23.1	20.8
q**	-	0.0	0.0	0.0	0.06	-0.15	-0.07	0.0	0.0
I (cm) ***	1.0	1.4	1.4	1.4	3.0	3.0	3.0	4.2	4.2
P (cm) ***	0.0	0.4	0.9	2.8	4.9	6.4	8.8	8.8	10.0

DAP = Days after planting

*Storage S (cm/100 cm of soil depth)

**Flux q (cm/day). Drainage $D = \Sigma q \Delta t$ (cm)

***I and P are cumulative values of irrigation and precipitation respectively, until the indicated days after planting.

QUESTION 3 (20 MARKS)

ii) Describe the basket of technologies in conservation farming. **(8 Marks)**

iii) Describe the impacts of the technologies in agricultural production. **(6 Marks)**

iv) Explain the role of conservation farming in the future. **(6 Marks)**

QUESTION 4 (20 MARKS)

I) Describe photosynthesis. **(4 Marks)**

II) What are the distinguishing features of C_4 and C_3 plants? **(6 Marks)**

III) How is the dry matter of plants produced through photosynthesis? **(10 Marks)**

QUESTION 5 (20 MARKS)

A. Give the scientific and family names as well as places of origin of the following crops: maize, cowpea, pineapple, papaya (pawpaw) and cassava. **(8 Marks)**

B.

i) Briefly describe the morphological features of maize, groundnut and pineapple. **(4 Marks)**

ii) Describe the optimum conditions of growth for each of the crops listed above. **(4 Marks)**

iii) Give the importance of each of the listed crops in the national economy. **(4 Marks)**

END OF EXAM

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
Fourth Year Examinations for Bachelor of Agricultural Sciences
AGC 411 FIELD CROP PRODUCTION
First Semester 2009
Date: 13th November 2009   Time: 14.00 – 17.00 hrs

1.   A farmer in Lusaka Province is engaging in wheat and cotton production for the first time. As an extension officer, advise the farmer on the type of basal dressing to apply and why?   **(6 marks)**

2.   A farmer in Choma district is engaging in cassava production.

   a.   What are the different methods of planting cassava?   **(1.5 marks)**
   b.   Which method of planting gives the highest number of unproductive branches?
                                                                          (1 mark)
   c.   How is planting done under this method? Illustrate your answer with a diagram.
                                                                          (4 marks)
   d.   When there are a lot of unproductive branches, what does the farmer need to do and why?   **(6 marks)**
   e.   What does spacing in cassava depend on? Give the recommended spacing(s) for the crop.   **(6 marks)**

3.   A farmer suspects Rust on her bean crop. As an Agricultural Officer, how can you confirm her suspicion? What remedial measures should to be taken against rust when detected?   **(10 marks)**

4.   Soyabeans are harvested as soon as they mature. What happens if soyabeans are not harvested on time? When is the best time of the day to harvest soyabeans?   **(5 marks)**

5.   You have been engaged as an Entomologist Consultant to give a guest lecture to 3rd Year, Agricultural Science students at the University of Zambia (UNZA) on bollworms, leaf eaters and stainers. What information would you include in your notes concerning the following:

   a.   Damage caused by each of these pests.   **(10 marks)**
   b.   Indicators to guide the farmer as to when to spray after scouting. Your answer should include scientific names.   **(10 marks)**

6.   Describe how conventional agricultural practices degrade the soil and lead to declining soil fertility.   **(10 marks)**

7.   Describe how practicing conservation agriculture might alleviate or mitigate crop water stress during a drought.   **(6 marks)**

END OF EXAM

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF CROP SCIENCE
FINAL EXAMINATION

COURSE NAME: PRINCIPLES OF WEED MANAGEMENT
COURSE CODE: AGC531
VENUE: SPORTS HALL
DATE: FRIDAY 13ᵀᴴ NOVEMBER 2009
TIME: 14:00 – 17:00hours

INSTRUCTIONS

Section I is compulsory. Answer everything. Section II has three questions. Answer only two. Points for each question are indicated.

SECTION I
COMPULSORY

Q1 (30 points)

a) Amensalism, competition and parasitism are all important crop-weed interactions. Define each separately and provide brief explanations on how each affects the crop, with examples.

b) Weeds cause many types of losses in agriculture. Some however cannot be readily related to them. List eight these.

c) Write short notes on the following
   a. Weed management.
   b. Triazines .
   c. Solarisation.

SECTION II
OPTIONAL

Answer only two questions from this section.

Q2 (15 points)

a) Define the innoculative and innundative approaches to biological weed control and give at least two concrete examples.

b) Compare and contrast the two strategies.

Q3 (15 points)

Define and discuss integrated weed management and give two practical example of its usage.

Q4 (15 points)

a) Write brief notes on herbicide chemistry bringing out the three cardinal aspects for agriculture.

b) List twenty (20) weeds of agricultural significance present in Zambia from **FIFTEEN** different families by **FULL** scientific name. Five of them should be grasses.

-End of Examination-

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2009 ACADEMIC YEAR FIRST SEMESTER EXAMINATIONS

AGE 211: FUNDAMENTALS OF MICRO-ECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

1. (a) What is an indifference curve? (4 Marks)

   (b) What are the characteristics of an indifference curve? (4 Marks)

   (c) Draw indifference curves for perfect substitutes and perfect complements. (4 Marks)

   (d) What is the difference between cardinal utility and ordinal utility? (4 Marks)

   (e) Muleya allocates K200 of her monthly food budget between two goods: meat and potatoes. If meat costs K4 per Kg and potatoes K2 per Kg. Draw Muleya's budget constraint, if income increases to K400, what is the new budget constraint? (4 Marks)

2. (a) Show as clearly as possible using a diagram the income and substitution and total effects of a normal good. (10 Marks)

   (b) With the aid of a diagram show the relationship between total physical product, marginal product and average product. Also show the stages of the production function. Why should the producer not produce in stage one? When total physical product is at a maximum, what is the value of marginal product? (10 Marks)

3. The following table shows the demand curve facing a monopolist who produces at a constant marginal loss of K10.

Price	Quantity
K27	0
24	2
21	4
18	6
15	8
12	10
9	12
6	14
3	16
0	18

(a) Calculate the firm's marginal revenue curve. (5 marks)

(b) What are the firm's profit maximizing output and price? What is its profit? (5 Marks)

(c) What would the equilibrium price and quantity be in a competitive industry? (5 Marks)

(d) What would the social gain be if this monopolist were forced to produce and price at the competitive equilibrium? (5 Marks)

4. (a) The kinked demand curve describes price rigidity. Explain how the model works. Why does price rigidity arise in oligopolistic markets? (5 Marks)

(b) Suppose the demand function is $Qd = 28 - 2P$ and the supply function is $Q_S = 4 + 4P$ where P is the price of maize in kwacha per Kg, and Q is the quantity in millions of tons. Find the free market equilibrium price and quantity. (5 Marks)

(c) Why is it only in the long-run that perfect competition yields an optimum allocation of resources? What happens in the short term? (5 Marks)

(d) List the condition required for perfect competition (5 Marks)

5. Explain what you understand by the following concepts:

(a) Isoquant (4 Marks)

(b) Marginal Rate of technical substitution.(4 Marks)

(c) Transitivity. (4 Marks)

(d) Implicit costs. (4 Marks)

(e) Production possibility curve. (4 Marks)

END OF EXAM

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2009 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS
AGE 411: INTRODUCTION TO AGRIBUSINESS MANAGEMENT
TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER **FIVE** QUESTIONS **ONLY** (i.e. ANSWER **ALL** QUESTIONS IN **SECTION A**; THEN **SELECT TWO** QUESTIONS FROM SECTION B)

SECTION A

Q1. Roy, a sale trader extracted the following Trial Balance from her books at the end of the business on 31st March, 2008.

	DR (K 000)	CR (K 000)
Purchases and Sales	45,800	88,500
Stock 1 April 2007	5,500	-
Capital on 1 April 2007	-	20,000
Bank Overdraft	-	4,500
Cash on Hand	1,200	-
Discount Allowed and Received	2,400	2,600
Sales Returns and Purchase Returns	1,700	1,900
Rent and Insurance	2,200	-
Carriage Inwards	2,800	-
Carriage Outwards	4,200	-
Provision for Bad debts	-	400
Fixtures and Fittings at cost	14,800	-
Delivery Van at cost	16,800	-
Debtors and Creditors	6,600	5,800
Salaries and Wages	18,000	-
Accumulated Depreciation	-	6,300
Drawings	8,000	-
	130,000	**130,000**

Notes:

a) Stocks on 31st March 2008 were valued at K6, 000,000
b) Salaries and wages accrued by K2, 500,000
c) Rent was pre paid by K200, 000
d) Increase provision for bad debts so that it is 7.5% of the debtors
e) Provide for depreciation as follows:
   Delivery van 20%
   Fixtures and fittings 10%

Required: Prepare the following financial statements for the year ended 31st March 2008

i) Trading and Profit and Loss Account **(15 Marks)**
ii) A Balance sheet as at that date**(15 Marks)**

2 What makes a corporation unique from other legal business forms? **(20 Marks)**

3 a. Bataties farm is a producer of Irish potatoes. The following information has been given regarding its performance.

- Area under potatoes   0.5 ha
- Annual Marketed production 500 x 10 Kg pockets
- Total Sales Revenue   K 5,000,000
- Total Variable Cost   K 2,250,000
- Total Fixed Costs   K 1,750,000

Required

i. Calculate the number of pockets required to break even? **(3 Marks)**

ii. What is the farm's margin of safety? **(1 Mark)**

iii. Supposing the owner wanted to make a net profit of K 1, 250,000 how many pockets of potatoes should he sell? **(2 Marks)**

iv. List four assumptions of the profit volume analysis **(2 Marks)**

v. List four limitations of the cost volume analysis **(2 Marks)**

b. Briefly discuss the legal, marketing and price risks faced by agribusinesses in Zambia and that strategy that can be used to manage or minimize them **(10 Marks)**

4 a. Argue out the case that human resource is the most important resource for an agribusiness **(5 Marks)**

  b. Explain the responsibilities of a Human Resources Manager **(10 Marks)**

5. Discuss the factors that may be considered in determining the optimal capacity of an agribusiness **(15 Marks)**

6. i) Highlight four reasons why the agribusiness sector may be considered unique **(4 Marks)**

   ii) Briefly discuss three emerging trends facing the agribusiness sector and how they have impacted the sector **(3 Marks)**

   iii) What assumptions are made by scientific management school and why is this school of thought criticized by many scholars? **(4 Marks)**

   iv) Outline Maslow's hierarchy of needs and explain its relevance in management? **(4 Marks)**

END OF EXAM

AGE 511
AGRICULTURAL ORGANIZATION AND ADMINISTRATION

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER FOUR FOR A TOTAL OF FIVE QUESTIONS. EACH QUESTION IS WORTH 20%. PLEASE WRITE LEGIBLY.

TIME: 3 HOURS   DATE: 2nd NOVEMBER 2009

(a) What are the five (5) management functions? Elaborate by citing an example of a specific activity related to performing each of the functions you have defined.

(b) What are the three skill areas that managers should posses and apply? Cite an appropriate example illustrating the application of each type of skill area. You should also briefly comment on the skill mixtures needed by managers at various levels of management.

(c) Briefly outline the roles which managers typically play.

(a) What are the major features of a bureaucratic organization as described by Max Weber? You should also outline the disadvantages or limitations of bureaucratic organizations.

(b) Briefly outline the principles of administration as propounded by Henri Fayol

(a) Describe the communication process. Outline 5 internal barriers to communication?

(b) What is a Management information System (MIS)? Citing relevant examples, explain how a MIS can be used to carry out 3 management functions

(a) Explain what Employee Assistance Programmes (EAP) are. Giving relevant examples, elaborate the importance of EAPs and what is involved in carrying out EAPs in management.

(b) What is Performance Appraisal? Why is performance appraisal important to both the supervisor and the subordinates?

(a) An agribusiness firm has high absenteeism and other personal problems among its junior staff. Outline the overt, measurable and hidden losses that the organization suffers. You should also briefly comment on the legal and social implications of these problems.

(b) As a Manager in this agribusiness firm, how would you apply Maslow's theory in motivating employees in the workplace? Cite relevant examples to illustrate your application.

(a)Discipline is an important management duty. Outline the principles you would practice in maintaining discipline among subordinates.

(b) Conflict commonly occurs in organizations. Explain the principle methods of interpersonal conflict resolution you would practice to deal with peers or subordinates.

Write brief notes explaining salient aspects of the following:
(a) Herzberg's two-factor theory of motivation
(b) Bases of Leadership Power
(c) Matrix Organizational Structure
(d) Human Resource Planning

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2009 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGE 521: INTRODUCTION TO FARM MANAGEMENT

TIME: THREE (3) Hours
INSTRUCTIONS: Answer All Five (5) Questions
MARKS: 100 TOTAL (Each question carries 20 Marks)

Q1. a) What is Tactical Farm management? **(2 marks)**

b) Explain the characteristics of Farm decisions **(15 marks)**

c) What are the major functions of management? **(3 marks)**

Q2. Malita has 2 ha of land on which she normally grows sorghum (1.5 ha) and tomatoes (0.5 ha). She has enough water to irrigate 0.6 ha of tomatoes. She recently attended a farmer's association meeting where she learned three things:
- There was a shortage of tomatoes in the city. As a result the price of tomatoes was going to increase from an average of K500 000 per ton to possibly K550 000 per ton.
- Very late rains are expected this year and that there could be a 30% decrease in her sorghum yield.
- The price of manure was going to increase by as much as 50% in the next season.

Current Gross Margin information

Item	Sorghum	Tomato
Yield	1t/ha	10t/ha
Price	K650 000/t	K500 000/t
Total Variable Costs (including manure + Harvesting costs)	K350 000/ha	K3 000 000/ha
Manure cost	K50 000/ha	K50 000/ha
Harvest cost	K100 000/ha	K100 000/ton

Using the information given above, answer the following questions using a sensitivity analysis.

a) What will be the effect of the increased tomato price on tomato profitability? **(4 marks)**
b) What will be the effect of the decreased sorghum yield on sorghum profitability? **(4 marks)**
c) What will be the effect of the increased manure price on sorghum profitability? **(4 marks)**
d) What will be the effect of the increased manure price on tomato profitability? **(4 marks)**
e) How much of each crop should Malita plant next year? **(4 marks)**

Q3. Given the following information for a Kabanje Farmer: **December 31, 2009**

Cash at hand K150 million	Average Asset value: K220 million
Grain in storage K70 million	Average Equity value: 105 million
Accounts receivable K30 million	Total Revenue: K120 million
Accounts payable K100 million	Opportunity cost of labor: K17 million
Notes payable K100 million	Opportunity cost of Management: K7 million
Net farm income+ Gain/loss in sale of capital Asset: 40 million	Family living expenses: K15 million Tractor with K8 million Book Value sold at: K10 million
Interest Expenses: K14 million	Opportunity cost of capital: 12 %
Long term debt: K200 million	Loan payment due in 6 months: K5.5 million

Compute values for each of the following items:
   a) Return to Unpaid Labor **(4 marks)**
   b) Return to Management **(4 marks)**
   c) The Current ratio **(4 marks)**
   d) Operating Profit Margin ratio **(4 marks)**
   e) Rate of Return on Equity **(4 marks)**

Q4. a) Maize yields 8000 kg per hectare and has a production cost of K1.4 million per hectare. Current market prices are K1, 300/kg for maize and K4, 5000/ kg for soybean. Soybean can be grown at a production cost K1 million per hectare. At what breakeven yield per hectare would you generate the same net return per hectare as maize? **(6 marks)**

b) Identify and explain differences between a cash flow budget and a Whole farm budget?
(6 marks)

c) What role does Linear Programming (LP) play as a tool to help in developing a whole farm plan and whole farm budget? **(4 marks)**

Q5. a) Mr. Moya is consideration putting up an irrigation scheme; explain three major considerations he must consider in evaluating this investment **(6 Marks)**

   b) Explain the causes of the following types of risk in farming
   i) Financial risk **(4 marks)**
   ii) Legal risk **(4 marks)**

   c) Explain how the following affect investments and how they should be treated in making investment decisions
   i) Inflation **(3 marks)**
   ii) Income taxes **(3 marks)**

2

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPT. OF AGRIC. ECONOMICS AND EXTENSION EDUCATION

FIRST SEMESTER FINAL EXAMINATIONS – 2009 ACADEMIC YEAR

AGE 531 - INTERNATIONAL AGRIC. MARKETS, TRADE AND DEVELOPMENT

DURATION: THREE (3) HOURS

INSTRUCTIONS:
  1. Read the questions carefully and answer all the questions.
  2. Points allocated to each question are in parenthesis. The examination is worth 100 points.

---

1) *The Classical Theory of International Trade*

   a) Using the Ricardian model as the basis for trade, is there any incentive to trade if two countries (Zambia and Zimbabwe) have similar labour productivities and workforce in the production of two agricultural commodities (maize and wheat)? Explain. **(4)**

   b) Consider a Ricardian model. Suppose Zambia's unit-labour requirement for timber is 3, its unit-labour requirement for fertiliser is 8 and it has 4.8 million workers. Suppose South Africa's unit-labour requirement for timber is 6, its unit-labour requirement for fertiliser is 2 and it has 4.8 million workers.
   - i.   Calculate each country's fertilizer autarky price ratio and the price ratio when there are no trade restrictions. **(6)**
   - ii. What are the levels of production and the pattern of trade when free trade occurs? **(4)**
   - iii. Calculate real wages for workers in both countries (in terms of both goods) in free trade. **(6)**

2) *Instruments of Trade Policy*

   a) The United States, a large country in the grain market, has the following demand and supply curves for grain:
$$D = 150 - 0.6P$$
$$S = -40 + 0.5P$$

   where D and S are in millions of tons and P in $ per ton.

   - i.   Depict the free trade equilibrium showing the price and quantity traded if the net import demand curve for the rest of the world is: $MD = 50 - 0.1P^*$. **(4)**

ii. What will be the new world market price and US domestic price if the US provides a specific export subsidy of $40 per ton? **(2)**

iii. Compute the welfare effects of the U.S. export subsidy on each of the following groups: U.S. grain producers; U.S. consumers; U.S. government budget; Foreign countries. **(8)**

b) The Zambian government intends to introduce an export tax on wheat. Using partial equilibrium analysis, with realistic assumptions, discuss the merits and demerits of such a trade policy proposal. **(6)**

3) Consider the following data for a fictitious country, Mojoland.

	Unit Req. for Cotton Prod.	Unit Req. Dairy Prod.	Resource endowments
Labour	$a_{LC} = 3$	$a_{LD} = 2$	$L = 600$
Capital	$a_{KC} = 1$	$a_{KD} = 2$	$K = 240$

a) Which industry is capital intensive and which one is labour intensive? Why. **(2)**
b) Write down the capital and labour constraint functions for the above data. **(2)**
c) What are the equilibrium output quantities for both goods? **(4)**
d) Suppose the labour endowment, L, increases to 720, what happens to the equilibrium output quantities for both goods? State the theorem that mirrors this change in resource endowments. **(4)**
e) Graph the effects of the change in labour resource endowment. **(4)**
f) Compute the percent changes in endowments and outputs and state the magnification effect for quantities resulting from this change. **(4)**

4) *International Finance*
   a) Discuss, with relevant graphical illustrations, the model of exchange rate determination used in the goods and services market equilibrium. **(10)**

   b) Suppose Angola's inflation rate is 25% over one year but the inflation rate in South Africa is only 5%. According to relative PPP, explain what should happen over the year to the value of the South African Rand in terms of the Angolan Kwanza? **(4)**

   c) Zimbabwe recently adopted the US dollar as its currency. This is also referred to as dollarization, a type of fixed exchange rate system. Using your expert knowledge of International Finance, outline and discuss two criteria that were used to select the US dollar as the currency in Zimbabwe. **(6)**

5) *Institutions and Trade Policy*

   a) What is dumping? What does the WTO Anti-dumping agreement stipulate on how to deal with this problem? **(6)**

   b) Describe the three_main policy strategies for economic development that have been pursued by developing countries post World War II? For each strategy explain whether the results have been positive or negative. **(14)**

------------------ **End of the Examination** ------------------

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2009 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS
AGE 541: AGRICULTURAL PROJECT PLANNING AND APPRAISAL
TIME: THREE HOURS
INSTRUCTIONS:
   i)   **Answer all questions**
   ii)   **Leave the discount tables in the examination hall**

1. a) Why is choosing a discount rate important in project analysis? Describe and explain briefly the discount rates that can be used in both financial and economic analysis. (14 marks)

   b) "Projects are the cutting edge of development" (Gittinger). Explain how relevant this assertion is to the Zambia's Fifth National Development Plan currently under implementation up to 2010. (6 marks)

2. The following investment outlay, operation and maintenance costs (cash outflows) as well as gross benefits (cash inflows) are given for a jatropha production and processing project proposal.

Amounts in K'million				
Year	Investment Outlay	Operation and maintenance	Production Cost	Gross Benefit
1	400	0	0	0
2	350	0	0	0
3	300	0	0	0
4	250	0	0	0
5	200	0	0	0
6	0	25	35	670
7	0	30	40	770
8	0	30	50	880
9	0	30	60	990
10	0	30	60	990

a) Compute the Net Benefit-Investment (N/K) ratio if the opportunity cost of capital is 20%. On the basis of the N/K you obtain, would you recommend the project as good investment? Explain why? (6 marks)

b) Compute the Internal Rate of Return (IRR). On the basis of the IRR you obtain and given 20% as the opportunity cost of capital, would you recommend the project as good investment? Explain why? (10 marks)

c) Suppose in another project you are informed that at an opportunity cost of capital of 20%, a 30% reduction in the project's net benefits results in a positive net present value of K+20,000, whereas a 35% reduction in the project's net benefits results in a negative net present value of K-26,000. What is the magnitude (switching value) of the net benefits decrease before the project's net present value falls below an unacceptable level? Explain your answer. (4 marks)

3. The foreign exchange component and the domestic currency component of a phosphate production project are as given in the following table:

Year	Foreign Exchange Component (US$'000)			Domestic Currency Component (K'million)	
	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	0	100	0	350	0
2	0	150	0	300	0
3	0	150	0	200	0
4	100	0	100	150	120
5	450	0	200	0	150
6	600	0	300	0	150
7	600	0	300	0	150
8	600	0	300	0	150
9	600	0	300	0	150
10	600	0	300	0	150

a) If the opportunity cost of capital is 20%, compute the domestic resource cost (DRC). If the official exchange rate (OER) is K4, 600 to US$1 and on the basis of the DRC you obtain, is the project favourable? Explain why? (10 marks)
b) If there is a foreign exchange premium of 20%, what is the shadow exchange rate (SER)? In the light of the SER you obtain and on the basis of the DRC you obtained in a) above, would you say the project is favourable? Explain why? (5 marks)
c) What are the limitations of the DRC as a tool of project analysis? (5 marks)

4. a) The c.i.f. price for a centre pivot irrigation system is US$105,000; the import levy is 10% of the c.i.f. price; the domestic handling and marketing charges amount to K10 million and transportation to the project site is K5 million. The official exchange rate (OER) is K4, 600 to US$1 and the foreign exchange premium is 20%. Compute the economic import parity values at farm gate or project boundary using the conversion factor and the shadow exchange rate approaches. (10 marks)
b) Why is economic analysis carried out in project preparation? (4 marks)
c) How do you go about converting financial prices into economic values? (6 marks)

5. Write short notes on the following giving formulas and/or examples where appropriate:
   a) Advantages of the project format (5 marks)
   b) Determining the premium on foreign exchange (5 marks)
   c) Benefit-Cost Ratio (5 marks)
   d) Direct transfer payments (5 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2009 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGF 411: UNIT OPERATIONS IN FOOD ENGINEERING 1

TIME: THREE HOURS

INSTRUCTIONS:

1. Please read the instructions and each question carefully.

2. Answer **ALL** questions.

3. **ALL** questions carry equal marks.

4. Only long formulas are provided on the last page.

****

1. a) The batch and CSTR reactors are commonly used in the brewing industry. Describe each in **few words** and state their two advantages and two disadvantages. **(7 points)**

   b) Centrifugal separations are commonly used in the food industry, describe the principal and give examples of food products that can be separated by this method. **(5 points)**

   c) What is Grass Transition Temperature? Why is it important in the storage of powdered food products? **(6 points)**

   d) Describe problems that occur during handling, storage and transportation of powdered food products and why? How can each of these problems be avoided or solved? **(7 points)**

2. Skim milk is prepared by the removal of some of the fat from whole milk. This skim milk is found to contain 90.5% water, 3.5% protein, 5.1% carbohydrate, 0.1% fat and 0.8% ash. If the original milk contained 4.5% fat, calculate its composition assuming that fat only was removed to make the skim milk and that there are no losses in

processing(**25points**)

3. Mifchoc, a newly developed food drink by your company has the rheological properties that can be approximated reasonably well by the power law model over the shear rate range of 10 to 50 s $^{-1}$. At 20°C, this drink has the viscosity of 84 x 10^{-3} Ns m^{-2} ,density of 910 kg m^{-3} and the flow behaviour index n is 0.2 . According to the process design the product has to be transferred from the reactor immediately after processing along a 170 m horizontal steel pipe of 5 cm diameter that connects the reactor and the storage tank.

a) Calculate the pressure drop along the pipe (**10 points**)

b) What will be the approximate values of shear stress? (**10 points**)

c) Differentiate between Newtonian and Non Newtonian fluids (**2.5 points**)

d) What are the losses expected by the a fluid when it is passing through the pipe (**2.5 points**)

4. In the filtration of a certain colloidal food material the initial period is affected at a constant rate with the feed pump at full capacity until the pressure reaches 400 kN/m^{2}. The pressure is then maintained at this value for the remainder of the filtration. The constant rate operation requires 900 s, and one-third of the total filtrate is obtained during this period.

a) Neglecting the resistance of the filter media, determine the total filtration time (**13 points**)

b) In your own words, define filtration (**6 points**)

c) The fluid, i.e. filtrate is always the only valuable product that can be obtained from the filtration process. TRUE OR FALSE (**6 points**)

END OF EXAMINATION
GOOD LUCK

2

FORMULA LIST

$$E_{p1} + E_{k1} + E_{r1} = E_{p2} + E_{k2} + E_{r2} + E_f - E_c.$$

$$Z_1 g + v_1^2/2 + P_1/\rho_1 = Z_2 g + v_2^2/2 + P_2/\rho_2 + E_f - E_c.$$

$$Z_1 g + v_1^2/2 + P_1/\rho_1 = Z_2 g + v_2^2/2 + P_2/\rho_2$$

$$v_1^2/2 + P_1/\rho_1 = v_1^2 A_1^2 /(2 A_2^2) + P_2/\rho_2$$

$$t/(V/A) = [\mu rw/2\Delta P] \times (V/A) + \mu rL/\Delta P$$

$$tA/V = [\mu rw/2\Delta P] \times (V/A) + \mu rL/\Delta P$$

$$\Delta P = V/At \times \mu r[w(V/A) + L]$$

$$dV/Adt = V/At = \Delta P/\mu r[w(V/A) + L]$$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

First Semester Examination November 2009

AGF 421 THEORY

FOOD TECHNOLOGY I

INSTRUCTIONS

- ◆ Answer ALL questions
- ◆ Each question carries 12 marks
- ◆ Time: 3 hours
- ◆ Closed book examination

1. a) How does a hygroscopic product dry? Illustrate using a diagram.
        (6 marks)

    b) (i)   What is smoking of food?   **(1 marks)**
        (ii) Why is food smoked?   **(2 marks)**
        (iii) How is food smoked?   **(3 marks)**

2. (a) Describe the process of deep fat frying.   **(6 marks)**

    (b) How does multiple effect evaporation save energy in the food industry?   **(6 marks)**

3.   Short notes (discuss in five lines or less)
- Fricke   **(1 mark)**
- Freezer burn   **(1 mark)**
- Radura   **(1 mark)**
- Z value   **(1 mark)**
- Relative humidity   **(1 mark)**
- Pasteurization   **(1 mark)**
- Roller drier   **(1 mark)**
- D value   **(1 mark)**
- Hypobaric storage   **(1 mark)**
- Ethylene scrubber   **(1 mark)**
- Convective heat transfer coefficient   **(1 mark)**
- Log mean area   **(1 mark)**

4.   The heat resistance of micro-organisms is dependent on several factors. Some of the factors are intrinsic to the organisms and while others are extrinsic. Discuss these factors in detail and how they affect the heat treatment of the food.   **(12 marks)**

5. (a)   What are the effects of sterilization on foods?   **(6 marks)**

   (b)   Compare and contrast the effects of sterilization with the effects of a pasteurization process.   **(6 marks)**

Good Luck!

End.

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

First Semester Examination November 2009

AGF 421 FINAL EXAMINATIONS
PRACTICAL

FOOD TECHNOLOGY I

INSTRUCTIONS

- Answer **ALL** questions
- Each question carries 10 marks
- Time: 3 hours
- OPEN book examination

1. A cold store has a wall comprising 11 cm of brick on the outside, then 7.5 cm of concrete and then 10 cm of cork. The mean temperature within the store is maintained at -18°C and the mean temperature of the outside surface of the wall is 18°C.
   - Calculate the rate of heat transfer through the wall
   - Determine also the temperature at the interfaces between the concrete and cork layers, and the brick and concrete layers

2. Cans are sterilized according to the following t-T combinations in the critical point:

Heating stage:

Minutes after start of heating	Temperature (°C)
2	55
4	75
8	85
12	95
14	100
18	110
20	114
22	118
25	121.1

Holding stage is at 121.1°C

Cooling stage is identical although it is the reverse of the heating stage. A complete sterilization has to be obtained and this means that, when taking the microbial load of the product into account, a process value of 12 F_0 has to be obtained.

How long should the holding stage be when a conductive heating product is being sterilized?

3. a)   One face of an iron plate 1 cm thick is maintained at 100°C and the other is at 80°C. Assuming steady state conditions, calculate the rate of heat flux through the plate.

   b)   A water vapor-air mixture having a dry bulb temperature of 70°C has an absolute humidity of 65g H2O/Kg H_2O . What is the
   - wet bulb temperature
   - Enthalpy
   - Relative humidity of this mixture

4.   Determine the Z value for a micro-organism that has the following decimal reduction times: D110 = 6 minutes, D116 = 1,5 minutes, D121 = 0,35 minutes, and D127 = 0,09 minutes

Constants:
Heat conductivity coefficient (w/m.K): Steel 58, Iron 55 – 65, aluminum 220

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2009 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 511 – Unit Operations in Food Engineering II

Instructions: Answer <u>all</u> **questions.**
All questions carry equal marks.
Answer **sections 1 and 2 in separate booklets.**

Time allowed: Three (3) Hours

SECTION 1

1. After precipitation and draining procedures, it is found that 100 kg of fresh casein curd has a liquid content of 66% and this liquid contains 4.5% of lactose. The curd is washed three times with 194 kg of fresh water each time. Assume perfect washing, and draining of curd to 66% of moisture each time.

   a. Calculate the residual lactose in the casein after drying. **(7.5 marks)**

   b. Also calculate the quantity of water that would have to be used in a single wash to attain the same lactose content in the curd as obtained after three washings. **(7.5 marks)**

   c. Describe one application of liquid-liquid extraction. **(5 marks)**

2. It is often convenient to use a liquid in order to carry out a separation process. The liquid is thoroughly mixed with the solids or other liquid from which the component is to be removed and then the two streams are separated.

   a. Mention and describe the type of extraction in where both streams are liquids. **(5 marks)**

   b. Mention and describe the type of extraction involving two different streams solid and liquids. **(5 marks)**

   c. State the factors controlling operation during extraction. **(5 marks)**

   d. Write the rate equation and examine the effects of controlling factors. **(5 marks)**

3. Given that the Henry's Law constant for carbon dioxide in water at 25°C is 1.6 x 10^5 kPa (mole fraction)$^{-1}$.

    a. Calculate the percentage solubility by weight of carbon dioxide in water under these conditions and at a partial pressure of carbon dioxide of 200 kPa above the water. **(7.5 marks)**

    b. Mention one factor which determines liquids' capacity to dissolve solids. With a typical example describe graphically how this factor relates to temperature and to what extents the solid dissolves in liquid. **(7.5 marks)**

    c. Briefly discuss the following terms: **(5 marks)**

        i.   Washing

        ii.   Absorption

        iii. Extraction

        iv. Distillation

        v.   Drying

SECTION 2: Answer this section in <u>a separate booklet</u>.

1.   A hot solution of $Ba(NO_3)_2$ from an evaporator contains 30.6kg $Ba(NO_3)_2$/100kg H_2O and goes to a crystallizer where the solution is cooled and $Ba(NO_3)_2$ crystallizes. On cooling, 10% of the original water present evaporates. For a yield of 17.47kg $Ba(NO_3)_2$ crystals;

    a. Calculate the feed solution if the solution is cooled to 290K, where the solubility is 8.6kg $Ba(NO_3)_2$/100kg total water. **(12 marks)**

    b. Crystallizers are classified according to the method of crystallization. Discuss the difference between the circulating-liquid method and circulating magma method. **(8 marks)**

2. In order to concentrate 4536kg/h of a NaOH solution containing 10 wt% NaOH to a 20 wt% solution, a single-effect evaporator is being used with an area of 37.6m². The feed enters at 21.1°C. Saturated steam at 110°C is used for heating and the pressure in the vapour space of the evaporator is 51.7 kPa.

   a. Calculate the steam used, and the overall heat –transfer coefficient.

      (13 marks)

   b. A condensed milk manufacturer informs you that he is using a vertical-type natural circulation evaporator to concentrate his product. He further explains that his product has a burnt flavour and a brown color. Explain the cause of the problem and offer possible solutions.   **(7 marks)**

$F = D + B$

$x_D / R_D + 1$

$R_m / R_m + 1 = (x_D - y') / (x_D - x')$

$Rm = (x_D - y') / (y' - x')$

$q = 1\text{-}f$

$- q / 1\text{-}q$

$q = 1 + \dfrac{C_{pL} (T_b - T_F)}{\lambda}$

$q = - \dfrac{C_{pV} (T_F - T_d)}{\lambda}$

$L_o + V_2 = L_1 + V_1 = M$

$x_{si} = p / (p + 1)$

$C_p = 1.424 \, m_c + 1.549 \, m_p + 1.675 \, m_f + 0.837 m_a + 4.187 m_m$

$C_p = 1.675 + 0.025 \, w$

$\Delta H = mc (T_2 - T_1)$

$\Delta H_s = m_s H_s \qquad \text{or} \qquad \Delta H_s = m_c H_c$

From steam tables

$H_{s,543.1} = 2746.5 \text{ kJ} / \text{kg}$

$H_{c,155} = 627 \text{ kJ} / \text{kg}$

$\Lambda = H_s - hs$

$F = L + V$

$F x_F = L x_L$

$q = U A \Delta T$

$q = S(H_s - hs) = S\lambda$

$q = (H_2 + Hv) - H_1$

molar weight

Ba =	137.33			
N =	14.01	K	=	39.1
Cl =	35.45	H	=	2
$MgSO_4$ =	120	O	=	16

4

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2009 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

DEFERRED EXAMINATIONS

AGF 521 - Principles of Food Technology II

Instructions:

This paper has a total of **Seven (7)** questions and you are required to answer a total of **five (5)** questions

Answer **Question one (1) (Compulsory)** and **any other four (4)** questions of your choice.

All marks allocated to each question are indicated at the end of each question

Time allowed: **Three (3) Hours**

Question 1 (Compulsory)

You are a R&D officer of a food manufacturing firm in Lusaka. The marketing department has identified two liquid drinks, which they think if blended in a certain ratio, would produce a highly selling product. However, the two drinks are immiscible. The two drinks are labeled X and Y. Drink X is denser than Y. Drink Y is non-polar whereas X is polar. The blend of drink X and Y is envisaged to be sensorially liked by consumers if its blended in the ratio of X:Y – 10:1 by volume, respectively. The drink is also going to contain the following additives: xanthan, β-carotene, sodium caseinate, sucrose and tocopherol.

(a) How do you propose to blend X and Y into one blended drink with its additives (propose a flowsheet to explain your answer, give reasons for each step in the flowsheet. Also state which one is likely to be the continuous phase and why)

(10 marks)

(b) State and briefly, discuss three important destabilizing factors of your blend

(10 marks)

Question 2

(a) Write short notes on the following:

    i.   Marangoni effect

    ii. HLB value

    iii. Critical micelle concentration

    iv. Spreading coefficient of liquid droplets

    v. Zeta potential   **(10 marks)**

(b) Describe the disruption of a liquid droplet in a homogenizer under laminar flow conditions   **(10 marks)**

Question 3

(a) (i) Define van der waals interactions

      (ii) State and briefly explain three types of van der waals forces

      (iii)Which of the three types is prominent and why?   **(10 marks)**

(b) Emulsifiers can be classified in many ways. One of the broad classifications is as

    (i) Small molecule surfactants   **(3 mark)**

    (ii) Polysaccharides   **(3mark)**

    (iii) Proteins   **(4 marks)**

WRITE ON HOW THEY FUNCTION AS EMULSIFIERS

Question 4

a. Colloidal classification can depend on the continuous phase. State three major classes of colloids depending on that classification. Out of the three, pick one and give three sub classes with a typical example of a food for each sub-classs

                                             (10 marks)

b. A colloidal mill is one of the homogenizers used in the food emulsion industry to produce food emulsions. Explain how the colloidal mill works and state what type of raw material is suitable for the colloidal mill?   **(10 marks)**

Question 5

Discuss the extended EDL model, the so called, Stern + Gouy-chapman Model.

                                             (20 marks)

Question 6

(a) In a tree-form, show the classification of liquids based on rheology. Briefly, define each classification you mention. What is the relevance of this classification to a food scientist? **(14 marks)**

(c) What are viscoelastic materials? In your definition, give an example **(6 marks)**

Question 7

Calculate the required value of the stability ratio of Intra-lipid emulsions used for parenteral feeding in order to have a half-life of at least 2 years. These commercially available emulsions contain 20 g of purified soybean oil (δ=925 kg/m^3) as well as 1.2 g of purified egg lecithin (δ=1050 kg/m^3) per 100 ml of emulsion. The volume-equivalent particle diameter ϕ_{30} is 220 nm. It may be assumed that all lecithin is adsorbed to the O/W interface. The continuous phase is aqueous. **(20 marks)**

End of Exam *(FORMULAE AND CONSTANTS OVERLEAF)*

Formulae and constants for examination

$$\Gamma = -1/(R*T) * (d\gamma/d\ln C) = -C/R*T * d\gamma/dC$$

$$\Gamma = -(1/(z^+ + z^-))*1/(R*T)*(d\gamma/d\ln C) = -(1/(z^+ + z^-))*C/(R*T)*(d\gamma/dC)$$

$$\Sigma = 1/\Gamma$$

$$Pa_1 = (1/\Gamma)/N_A = \Sigma/N_A$$

$$\Delta P_L = 2\gamma/r = -2 \cdot \gamma \cdot \cos\theta/r_c = h \cdot \delta \cdot g$$

$$(2 \cdot \pi \cdot r_c) \cdot \gamma \cdot \cos\theta = (\pi \cdot r_c^2 \cdot h) \cdot \delta \cdot g$$

$$\mu = \frac{\zeta * \varepsilon}{1.5\eta} \qquad \text{Debye – Hückel equation}$$

$$\mu = \frac{\zeta * \varepsilon}{\eta} \qquad \text{Helmoltz-Smoluchowski equation}$$

$$\mu = \frac{v}{E}$$

$$\kappa = \sqrt{(2* Z^2 * F^2 * C_o / \varepsilon RT)}$$

$$\kappa = \sqrt{(2* Z^2 * e^2 * n_o / \varepsilon kT)}$$

$$\kappa = 1.04 * 10^8 \sqrt{(C_o * Z^2)}$$

$$R*T*\ln[P_{vr}/P_{vo}] = 2*\gamma*M/\delta*r = 2*\gamma*V_L/r$$

$$t_{1/2, slow} = W * t_{1/2, fast}$$

$$t_{1/2, rapid} = 3*\eta/(4*k*T*N_o) = 2*10^{17}/N_o \text{ at } 25^oC \text{ in water}$$

$$N_o = fv/[(\pi/6)*\phi^3]$$

$F = 96485$ C / Mole

$e = 1.602 * 10^{-19}$ C

$R = 8.314$ J / (mole.K)

$\varepsilon_o = 8.85 * 10^{-12}$ F/m

$k = 1.38 * 10^{-23}$ J/K

$N_A = 6.023 \times 10^{-23}$

δ_{H2O} at 22°C ≈ 1000 kg/m3

$g = 9.81$ m/s

$\pi = 3.14$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2009 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 521 - Principles of Food Technology II

Instructions:

This paper has a total of **Seven (7)** questions and you are required to answer a total of **five (5)** questions
Answer **Question one (1) (Compulsory)** and **any other four (4)** questions of your choice.
All marks allocated to each question are indicated at the end of each question

Time allowed: **Three (3) Hours**

Question 1 (Compulsory)

There are many factors or phenomena involved in destabilization of a well prepared emulsion. State **three** main factors or phenomena and discuss how they are involved in destabilization of emulsions?   **(20 marks)**

Question 2

(a) Write short notes on the following:

    i.   Marangoni effect

    ii.   Protein bridging

    iii.   Critical Electrolyte Concentration/Critical Coagulation Concentration

    iv.   Steric stabilization in emulsions

    v.   Depletion flocculation   **(10 marks)**

(b) Explain the behavior of proteins at a water-in-oil interface in relation to their conformation status. Support your answer by a diagram (s).   **(10 marks)**

Question 3

(a) Briefly discuss the concept of gelation with reference to **three (3)** modes of gel formation.   **(10 marks)**

(b) Explain what causes good and poor wetting behaviour of liquids on solid surfaces   **(10 marks)**

1

Question 4

a. State and very briefly explain **six** factors affecting the droplet size during homogenization or formation of an emulsion **(10 marks)**

b. There are three (3) types of flow conditions that are prevalent during emulsification. State the **three** types of flow conditions and explain how **the one with a well defined flow regime** is effective in bringing about droplet disruption. **(10 marks)**

Question 5

A droplet of soya oil is dispersed in an electrolyte solution of 0.1M of potassium chloride. Explain how the ions will distribute themselves around the droplet and give a reason(s) to your choice of distribution. **(20 marks)**

Question 6

(a) State the rheological classification of liquids and define each classification mentioned

(14 marks)

(c) What are viscoelastic materials? In your definition, give an example **(6 marks)**

Question 7

(a) In a micro-electrophoresis experiment, a spherical particle of diameter $0.5\mu m$ dispersed in 0.1 mol/dm^3 aqueous solution of KCl at $25^\circ C$ takes 8 seconds to cover a distance of 120 μm, the potential gradient being 10 V/cm. Assume D=78.55 and the viscosity (η) of water at $25^\circ C$ to be 0.89 Pa.s. Calculate

(i) the electrophoretic mobility of the particle **(3 marks)**

(ii) an approximate value of the zeta-potential of the particle **(7 marks)**

(b) Calculate the stability ratio, W, of a 20% (v/v) corn oil-in-water emulsion from the experimental observation that its half life is 1 month and the average droplet diameter is 700nm. Assume the experiment is performed at $25^\circ C$. Give a comment on the value of W obtained. **(10 marks)**

End of Exam *(FORMULAE AND CONSTANTS OVERLEAF)*

2

Formulae and constants for examination

$\Gamma = -1/(R^*T) * (d\gamma / d\ln C) = -C/R^*T * d\gamma / dC$

$\Gamma = -(1/(z^+ + z^-))^*1/(R^*T)^*(d\gamma / d\ln C) = -(1/(z^+ + z^-))^*C/(R^*T)^*(d\gamma / dC)$

$\Sigma = 1/\Gamma$

$Pa_1 = (1/\Gamma)/N_A = \Sigma/N_A$

$\Delta P_L = 2\gamma/r = -2 \cdot \gamma \cdot \cos\theta / r_c = h \cdot \delta \cdot g$

$(2 \cdot \pi \cdot r_c) \cdot \gamma \cdot \cos\theta = (\pi \cdot r_c^2 \cdot h) \cdot \delta \cdot g$

$\mu = \dfrac{\zeta * \varepsilon}{1.5\eta}$ Debye – Hückel equation

$\mu = \dfrac{\zeta * \varepsilon}{\eta}$ Helmoltz-Smoluchowski equation

$\mu = \dfrac{v}{E}$

$\kappa = \sqrt{(2* Z^2 * F^2 * C_o / \varepsilon RT)}$

$\kappa = \sqrt{(2* Z^2 * e^2 * n_o / \varepsilon kT)}$

$\kappa = 1.04 * 10^8 \sqrt{(C_o * Z^2)}$

$R^*T^*\ln[P_{vr}/P_{vo}] = 2* \gamma *M/\delta^*r = 2^*\gamma^*V_L/r$

$t_{1/2, slow} = W * t_{1/2, fast}$

$t_{1/2, rapid} = 3^*\eta / (4^*k^*T^*N_o) = 2*10^{17}/N_o$ at 25°C in water

$N_o = fv / [(\pi/6)^*\phi^3]$

$F = 96485$ C / Mole

$e = 1.602 * 10^{-19}$ C

$R = 8.314$ J / (mole.K)

$\varepsilon_o = 8.85 * 10^{-12}$ F/m

$k = 1.38 * 10^{-23}$ J/K

$N_A = 6.023 \times 10^{-23}$

δ_{H2O} at 22°C $\approx$ 1000kg/m3

$g = 9.81$m/s

$\pi = 3.14$

3
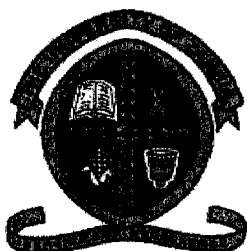
THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

Third Year Examinations for Bachelor of Agricultural Sciences
AGG 311: EXPERIMENTAL DESIGNS AND STATISTICS
First Semester 2009/10 Academic Year

DATE: Friday November 13th 2009, PM.   TIME: THREE HOURS
Answer five questions only. However Question 4 is compulsory   Marks

1.0   Write short notes on the following:
   a) The Linear Additive Model of a Randomized Complete Block Design
   b) The Latin Square Design S
   c) The **t** and χ^2 Distributions in statistical inference S
   d) The Nested or Hierachical Design S
   e) The use of expected mean squares in Experimental design S

20

2.0   A Dairy cow Breeding Company wishes to increase its market share of semen sales of its improved breed in the SADC set out to study whether or not its cash offer for the breed varies with the characteristics of the sales agent. The company selected one fine looking bull from its prime new breed for which cash offers were solicited from 24 big Dairy Farms in the SADC. Four sale agents were used in the study (denoted as H, I, J, K) and each agent was sent to the six dairy farms selected at random from the 24 in the study. The cash offers equivalent to millions of Zambian Kwacha was as presented in the table below.

DAIRY FARM	SALES AGENT			
	H	**I**	**J**	**K**
1	25	21	26	20
2	24	25	29	23
3	26	23	27	24
4	27	22	28	26
5	23	20	29	21
6	28	22	28	23

   a) Analyze the data and test whether or not cash offers vary for the four different sales agents.

$H \quad K \quad male$

$I \quad in \ J \quad female$

b) If sales agents H and K are males and I and J are females, examine differences in offers for male and female agents and also differences within each gender group and give comments.

3.0 Plant Breeders promoting a new biofuel crop Jatropha, state that the quickest way of selecting the best yielding varieties of this crop is by selecting on the basis of stem thickness at 24 months growth stage at a height of 30 cm from the ground. The following data are of plant stem diameter (x) in centimetres and the first yield (y), in kilograms per tree for six (6) Jatropha varieties.

x	30	50	10	60	20	40
y	160	250	80	290	110	190

a) Compute the regression parameters and show the Regression Prediction Formula.
b) Test whether the regression is statistically greater than zero.
c) Comment on your findings with respect to the usefulness of the stem diameter as a method for selecting high yielding varieties of jatropha.

ANSWER QUESTION 4

b_1

$\dfrac{b_1}{S(b_1)}$

20

4.0 It has been said that the problem of food production in Sub-Saharan Africa can be solved if the productivity of small scale farmers can be improved. One proposed strategy is to institute a policy that only Single Cross Maize Hybrid Variety Seed should be sold to farmers as opposed to the current practice which encourages small scale farmers to grow Open Pollinated (OPV) Maize varieties. The argument by some Plant Breeders is that Single Cross hybrid varieties can outperform OPV's even under the conditions of a resource poor farmer.

Design and clearly explain an experiment to compare the yield performance of OPV's and **different types** of maize hybrids under different fertilizer management conditions and give the form of the ANOVA.

$MSt/$

$\overline{(x.}$

The Fertilizer management conditions are as follows
1. No fertilizer applied
2. 25% of recommended commercial fertilizer application
3. 50% of recommended commercial fertilizer application
4. 75% of recommended commercial fertilizer application
5. 100% of recommended commercial fertilizer application

Eight (8) Maize varieties to be tested are as follows:
➤ Two OPV's
➤ Two Three way Crosses
➤ Two Double Cross Varieties
➤ Two Single Cross varieties

8   4

1.50

8   8

3 0   f   2 5×5

$\dfrac{10}{4}$

5.0 Recent research findings from the International Plant Genetic Resources Institute (IPGRI) have shown that Livingstone Potatoes (Umumbu as it is called in Kapirimposhi) are very high in β carotene

Two factors are said to influence the β carotene content of Livingstone Potatoes, these being Genotype and Soil Nitrogen. The genotype or factor A comprised of two local varieties and Soil Nitrogen or Factor B were two rates, that is, 50kg/ha N and 100kg/ha N. The response variable is β carotene concentrations in micro grams (μ grammes). Data is presented in the table below.

FACTORS		Treatment	REPLICATIONS			
A	B	combinations	1	2	3	4
-	-	(i)	18.2	18.9	12.9	14.4
+	-	a	27.2	24.0	22.4	22.5
-	+	b	15.9	14.5	15.1	14.2
+	+	ab	41.0	43.9	36.1	39.2

a) Analyze data from this experiment and interpret results
b) Draw the AB interaction plot and interpret this plot.

6.0 a) A vet student did a survey of the incidence of rabies in two areas of Lusaka Province. The following data are frequencies of dogs found with and without rabies in two different Geographical areas of Lusaka Province

Area	With Rabies	Without Rabies
1	14	29
2	12	38

Test the hypothesis that the incidence of rabies in dogs is independent of the area sampled

b) Consider the following data which are amino acid concentrations (mg/100 ml) in blood of local pigs: 240.6, 238.2, 236.4, 244.8, 240.7, 241.3, and 237.9.
  i.   Determine the range of the data
  ii. Calculate the "sum of squares" of the data
  iii. Calculate the variance of the data
  iv. Calculate the standard deviation of the data
  v.   Calculate the coefficient of variation of the data

7.0 It is recommended that mortar for building requires a mixing formulation of seven (7) wheel barrow loads of building sand with one 50kg packet of cement. A lecturer in Agricultural Engineering is however, of the opinion that a modified formulation where you mix eight wheel barrow loads of building sand with one

50kg packet of cement can give the same quality of mortar. To prove this, he did a series of modified and unmodified mortar formulations with his students in the Farm Structures class. He then determined the tension Bond strength of these mortar formulations. The tension Bond Strengths in Kg/cm^3 as shown in the table below

MODIFIED MORTAR	UN MODIFIED MORTAR
16.85	17.50
16.40	17.63
17.21	18.25
16.35	18.00
16.52	17.86
17.04	17.75
16.96	17.90
17.15	17.96
16.59	18.15
16.57	18.22

a) State the Null Hypothesis
b) Are the claims of the lecturer correct
   [**Do not** use the F –Test]

8.0 a) Discuss three error control measures employed in scientific experimentation

b) In animal the feed manufacturing process, the efficiency of mixing feed ingredients which are included in small quantities such as vitamin supplements is very important. The mixer is supposed to do a thorough mixing so that all the feed has the same composition of these ingredients.

A study was instituted to investigate the vitamin mixing efficiency at a fixed mixer speed for four different types of vitamin supplements, A, B, C, and D. Four mixers were employed in the experiment and each vitamin supplement was tested in each of the mixers. The tests, one vitamin supplement per mixer, were conducted on four different days.

Suggest the appropriate Design for this study and how you would measure the efficiency of mixing .Also present the form of the ANOVA table

---------------------------------END OF EXAMINATION---------------------------------

4
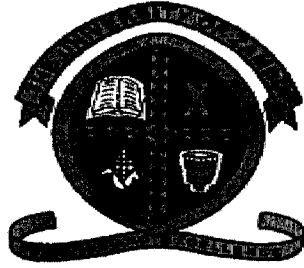
UNIVESITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

CROP SCIENCE DEPARTMENT

UNIVERSITY EXAMINATIONS

AGG 521 ADVANCED PLANT BREEDING   **NOVEMBER 2009**

INSTRUCTIONS
Answer Question No. 1 and any other THREE. Points for each question are indicated in brackets.
TIME: 3 hours

Q. 1 A plant breeder studied the genetic basis of the salinity tolerance of Maize using the Triple Test Cross method. Maize accessions with differing responses to NaCl stress were used based on seedling root growth in the solution culture using the triple test cross design.

Males (L1, L2, L3 and L4) were crossed to three testers P1 (sensitive), P2 (tolerant), and F_1. The progenies resulting from these matings were evaluated for the seedlings root growth in saline solution and the root lengths (cm) are in a table below:

Task:
    (i)   Test for the presence or absence of epistasis
    (ii)   Assume there is no episistasis, estimate the additive and dominance genetic variance
             components.

Treatments	Replication 1	Replication 2
Hybrids		
L1 X P1	41.6	41.8
P2	46.5	44.7
F1	43.5	42.4
L2 X P1	39.0	38.9
P2	50.4	49.5
F1	47.2	40.1
L3 X P1	29.6	32.1
P2	42.1	40.8
F1	39.9	34.3
L4 X P1	42.9	35.8
P2	49.9	43.0
F1	51.8	40.6
Accessions		
L1	39.8	35.3
L2	34.0	34.4
L3	35.1	45.6
L4	29.6	33.1
Testers		
KL 100	33.0	35.8
Zea 100	54.0	55.0
Pirlo	47.9	46.1

(40 points)

Q. 2 Define selection. Explain in details how selection can be improved, highlighting the limitations that may be encountered. **(20 points)**

Q. 3 Describe three uses of polyploidy in plant breeding giving examples of the uses. **(20 points)**

Q.4 Write short notes on the following:
(a) Five situations under which Marker Assisted Selection would be recommended (**10 points**)
(b) Strategies used to develop an experimental population for the North Carolina Design I and Design II. **(6 points)**
(c) Properties of the Hardy-Weinberg Equilibrium **(4 points)**

Q. 5 Give a detailed account of why germplasm conservation is important for plant breeding. What important aspects of plant genetic resources conservation do you see being necessary to be functional? **(20 points)**

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
FIRST SEMESTER DEFERRED EXAMINATIONS
AGS 211-FUNDAMENTALS OF SOIL SCIENCE I
November, 2009

INSTRUCTIONS

Time: 3 Hours.   **Answer all questions.**

1. Define the following terms: (**15 marks**)

    a) Pedogenic weathering
    b) Particle density
    c) Sedimentary rock
    d) Anaerobic chemoheterotroph
    e) Soil Texture
    f) Biological Nitrogen Fixation

2   Indicate whether the following statements are true or false. (**10 marks**).

    a) Facultative anaerobic soil bacteria can survive both in the presence and absence of oxygen in soil.

    b) A soil with a wet mean weight diameter of 3.7 mm and a dry mean weight diameter of 4.5 mm has a stable structure.

    c) The formation of soil parent material from granite is an example of geochemical weathering.

    d) A soil with colour 5YR 4/3 is redder than a soil with colour 7.5 YR2/3.

    e) A soil with a particle density of 2.65g/cm^3 that contains 0.4 cm^3 H$_2$O/cm^3 soil at saturation has a bulk density greater than 1.45g/cm3.

3   Answer the following questions briefly and concisely (**30 marks**)

    a) Define Streak and Hardness of minerals and describe how they are used in identifying minerals in the field or laboratory. (*7.5 marks*)

    b) Soil microorganisms are often classified on the basis of their sources of carbon, energy and terminal electron acceptors during metabolic processes. List and define the various classes of microorganisms based on (i) source of carbon, (ii) source of energy and (iii) terminal electron acceptors during respiratory processes. (7.5 marks)

    c) Describe how the Aggregate Instability Index of a soil is determined and how you interpret the results obtained. (7.5 marks)

    d) The silt and clay fractions of a soil contain the minerals KAlSi$_3$O$_8$, Al$_2$Si$_2$O$_5$(OH)$_4$, SiO$_2$, and FeOOH. (i) Name the minerals and indicate whether they are primary or secondary minerals.(ii) Write a balanced chemical weathering reaction of KAlSi$_3$O$_8$, to Al$_2$Si$_2$O$_5$ (OH)$_4$, by hydrolysis and indicate the names of all the reactants and products. (7.5 marks)

4. The A horizon of a soil from Liteta in Chibombo District has selected properties presented in the Table below:

ρ_b (g.cm^{-3})	θ_g (g.g^{-1})	Org C %	Total N mg/kg soil	Sand %	Silt %	Clay %	Soil Depth (cm)
1.25	0.104	2.03	310	40.8	21.8	37.4	20

Answer the following questions (22.5 marks):

a) How much organic matter is present a hectare of this horizon? (5 marks)

b) What is the total volume of water present in 2 Lima of this horizon? (5 marks)

c) Will mineralization of N occur in this soil when the organic matter is decomposed by soil microorganisms? Support your answer with a calculation. (5 marks).

d) How many kilograms of oven dry sand are present in 600 kg of moist soil from this soil horizon? (5 marks)

e) Plot the position of the textural class of this soil on the USDA Textural Triangle (2.5 marks)

5   Answer the following questions: (22.5 marks)

a) A soil loses 2.5 mg of organic carbon per kg per day due to microbial respiration. If the top 20 cm of 1 hectare of this soil contains 3000 kg of organic matter, how many kilograms of organic matter will remain in this soil after 5 months, assuming that the bulk density of the soil is 1.5 g.cm^{-3} and the respiration rate is constant during the 5 month period? (7.5 marks)

b) A 0.0001m^3 sample of soil weighs 0.174 kg. After oven drying, the soil sample weighs 155 g. Assuming the density of water is 1.0g.cm^{-3} and the particle density of the soil is 2.65g.cm^{-3}, answer the following:

i) What is the total density of this soil? (3 marks)

ii) What total volume of pores in this soil? (3 marks)

iii) How many litres of oxygen are present in the top 20 cm of 1 hectare of this soil if the soil air contains 17.5 % oxygen by volume? (5 marks)

iv) What will be the gravimetric moisture content of a 10 cm layer of this soil after receiving 15 mm of rainfall? (4 marks)

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER DEFFERED EXAMINATIONS-NOVEMBER, 2009

AGS 311
AGROCLIMATOLOGY

Time: Three (3) Hours   **Marks:** 87

Instruction: Answer all Questions

Note that for calculated values the number of decimal places should be rounded off to between one to three decimal places where possible

---

1. Briefly define each of the following terms as applied in Agro climatology.   *(20 marks)*

    a) Ectothermic temperature regulation
    b) Zero absolute temperature
    c) Basal Heat Production
    d) Zone of survival
    e) Solar Constant

2. With an aid of a diagram indicate all the components in percentages the earth's energy budget   *(20 marks)*

3. The earth's atmosphere is composed of four distinct layers based on its thermal properties. Describe briefly the main features of the lower and the upper most layers   *(12 marks)*

4. There has been significant level of consensus amongst scientists that there has been a global temperature change on Earth. What are these agreed changes according to IPCC (2001)?   *(10 marks)*

5. Given the following meteorological data measured this year (2008) Brussels, Belgium (04°23' E, 60°48' N and altitude 100 m): *(25 marks)*

Maximum air temperature	21.5°C
Minimum air temperature	12.3°C
Maximum relative humidity	84 %
Minimum relative humidity	63 %
Wind speed measured at 10 m height	10 km hr^{-1}
Estimated extraterrestrial radiation	476.644 W m^{-2}
Measured solar radiation	256.012 W m^{-2}
Inverse relative distance Earth-Sun	0.976 radians

$$1.0 \ MJ \ m^{-2} \ day^{-1} = 11.6 \ W \ m^{-2}$$

Determine:

a) Wind speed at standard reference height for agricultural uses **(m/s)**
b) Latitude of the site in *radians*
c) Solar radiation on a clear-sky day in *MJ m^{-2} d^{-1}*
d) Net shortwave radiation in *MJ m^{-2} d^{-1}*
e) Sunset hour angle *in degrees*

End of Exam

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS – NOVEMBER 2009

AGS 411
SOIL FERTILITY

TIME: 3 Hours   Marks: 85
INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. An understanding of soil reactions is important for good land management.

    a. Give three reasons why a good understanding of soil pH is important for agricultural productivity.   [6 Marks]
    b. What is the principle behind colorimetric methods of pH measurement?   [4 Marks]
    c. How can you lower the pH of an overlimed soil?   [4 Marks]

    d. List three (3) properties which affect the strength with which ions in the soil are held.   [3 Marks]
    e. Give three (3) characteristics of hydrogen reactions in the soil.   [3 Marks]
    f. Give two (2) types of reactions which are examples of exceptions to reversibility of cation exchange.   [4 Marks]
    g. What reactions do you expect to take place when water-soluble P is applied to the soil under different conditions?   [6 Marks]

2. Define the following terms:

    a. adsorbed ions   [2 Marks]
    b. complementary ion effect   [2 Marks]
    c. symbiotic N fixation   [2 Marks]
    d. iso-electric point   [2 Marks]
    e. rhizosphere   [2 Marks]

3. Nitrogen is one of the major nutrients.

    a. List the different steps in N mineralization and indicate the products in each of these steps.   [4 Marks]
    b. Define nitrification and write the balanced equations of the two main steps.   [4 Marks]
    c. Discuss the different ways in which N is lost from the soil and how the same processes can be prevented.   [12 Marks]
    d. What is the basic material for synthetic N fertilizers and how is it produced?   [3 Marks]

4. Clearly explain how the following P products are produced and also explain what these materials may be used for.

    a. SSP   [3 Marks]
    b. Orthophosphoric acids   [3 Marks]
    c. superphosphoric acids   [3 Marks]
    d. TSP   [3 Marks]

5. When you burn organic materials what are the likely benefits and loses to the soil in terms of soil fertility and give reasons?   [4 Marks]

6. Mn and Al can be expected to be toxic to plants within a certain pH range.

    a. In what pH range would you expect each one of the two to be toxic to plants? [2 Marks]
    b. Explain the usefulness of these elements to crops.   [4 Marks]

END OF EXAMINATION

UNIVERSITY OF ZAMBIA, 2009 FIRST SEMESTER EXAMINATIONS
AGS431

SOIL MINERALOGY AND MICROMORPHOLOGY
November, 2009

Instructions: Answer all questions: **Time: 2 hours**

1   Define the following : *(15 marks)*

     i.   [010]
     ii.   Phyllosilicates
     iii.   Dioctahedral silicate mineral
     iv.   Uniaxial Positive Mineral
     v.   Relief of a mineral
     vi.   Crossed Polarized Light
     vii.   Destructive interference

2   Indicate whether the following statements are true or false or whether you do not know the correct answer. *(16 marks)*. 2.0 marks for correct answer, -1.0 marks for wrong answer, and 0 marks for I don't know.

    a)   A mineral with $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$ is anisotropic and uniaxial

    b)   The conversion of goethite to hematite is an exothermic reaction associated with a loss in weight of 10.1 % in a sample of pure goethite.

    c) Cuk_β X-rays have a shorter wavelength than Ck_α X-rays.

    d)   X-rays reflected from the (001) planes of a crystal with a d-spacing of 0.344 nm that give a peak at a 2θ value of 30.16 ° have $\lambda = 0.179$ nm.

    e) $Al_2Si_2O_5(OH)_4$ is a the chemical formula of a phyllosicate mineral that can form from the weathering of orthoclase.

    f)   In the mineral $[(Mg_2Al)(OH)_6]Mg_3(Si_3Al)O_{10}(OH)_2$, the unit $[(Mg_2Al)(OH)_6]$ occurs in the interlayer space of the mineral.

    g)   A sample of limestone containing calcite as the only carbonate mineral, which upon heating to give off CO_2 experiences a weight loss of 36 %, contains more than 80 % calcite.

    h)   Zircon ($ZrSiO_4$), a common heavy mineral in the sand fraction of soils that has $n\omega = 1.923$-1.960 and $n\varepsilon = 1.961$-2.015, is a uniaxial positive mineral in which light travels at a speed of not less than 1.49 x 10^8 m/s.

3 Answer the following questions briefly and concisely: *(27 marks)*

a) Draw the structures of Kaolinite and Muscovite. (*5 marks*)

b) Describe the main characteristics of a clayey soil dominated by montmorillonitic clay *(4 marks)*

c) What common land use would you recommend for a clayey soil dominated by montmorillonitic clay? Give reasons to support your answer. (2 marks)

d) What is Mica alteration? Give examples of it. (2 marks)

e) Define desilication and indicate the three main stages of desilication. (3 marks)

f) What are oxides, hydroxides and oxyhydroxide minerals? Give examples of common minerals that belong to each of these groups. (5 marks)

g) What are silicate minerals? Discuss the classification of silicate minerals based on their structural arrangements of the constituent ions and give examples of common minerals belonging to each of the major classes of silicate minerals. (6 marks)

4 There is a deposit Gypsum at Lochnivar National Park in Monze. An analysis of Gypsum crystals from this deposit reveals that they have the following crystallographic properties: (35 marks)

$n\alpha = 1.519$-1.521
$n\beta = 1.523$ -1.526
$n\gamma = 1.529 - 1.531$
$\alpha = 90°$, $\beta = 113.5°$, $\gamma = 90°$
Unit cell lengths; $a = 0.568$ nm, $b = 1.518$nm, $c = 0.629$ nm
Density $= 2.30$ to 2.37 g/cm3

Using the data provided above answer the following questions:

a) To what crystal system does Gypsum belong? Give reasons to support your answer. (*4 marks*)

b) To what chemical class of minerals does gypsum belong? (2 marks)

c) What is the birefringence of this mineral? (*2 marks*)

d) Does Gypsum have an open or closed crystal form? Give reasons to support your answer (4 *marks*)

e) Is Gypsum a uniaxial or biaxial mineral? Explain (*3 marks*)

2

f) Does Gypsum polarize light? Give reasons to support your answer. (*4.0 marks*)

g) If a crystal of gypsum is adjacent to crystal of halite (n=1.545) in a thin section, towards which mineral will the becke line move when the crystals are brought out of focus by increasing the distance between the sample and the objective lense of a petrographic microscope? Give reasons to support your answer. (*3 marks*)

h) What is the axial ratio of gypsum? (*3 marks*)

i) If the Gypsum from Lochnivar is 80 % pure, how much of this gypsum would be needed to supply 80 kg of Sulphur? (*5 marks*)

j) If you are requested use this gypsum which is 80 % pure to reclaim a 40 hectare sugarcane field with sodic soils at Nakambala that requires an equivalent of 2 tonnes of pure oven dry gypsum per hectare, how many tonnes of the Lochnivar Gypsum would you require, if the gypsum has a gravimetric moisture content of 10 % contains ? (*5 marks*)

Atomic masses: $Ca= 40\ g$, $O = 16g$, $S=32g$, $H= 1\ g$

5   The X-ray diffractogram attached is the clay fraction of a soil from Bruce Miller Farm in Choma District. The analysis was carried using an X-ray diffraction machine that uses Cuk_{α} radiation with $\lambda=0.154$ nm. Answer the following questions. (*23 marks*)

   a) Calculate the d-values for the peaks on the diffractogram labelled, 1, 2, 3, 4 and 5. (*5 marks*)

   b) Identify the minerals responsible for the 5 peaks you have just calculated and write their chemical formulas. Give reasons to support your answers (*4 marks*)

   c) Which of these minerals had larger crystals the sample? Give reasons to justify the answer. (*4 marks*)

   d) If a TGA of 120 mg of the clay fraction of this soil shows a weight loss of 8 mg at 550° C, and a chemical analysis of the soil indicates a K content of 3 %, calculate the percentage contents of the two minerals identified by X-ray diffraction in the clay fraction of this soil and the percentage of other minerals not identified by XRD analysis present in the clay fraction. (5 marks)

   e) If the CEC of vermiculite is 120 meq/100g, that of smectite is 80 meq/100g; that of mica or illite is 20 meq/100g and that of kaolinite is 6 meq/100g, calculate the CEC per 100g of soil from Bruce Miller Farm, if it contains 30 % clay, assuming that the only sources of charge in the soil are the two minerals you identified by X-ray diffraction analysis (5 marks)

END OF EXAM

3

Sample 14bis: 05/102: Clay; Powderprep.; Zambia, Choma, Victor Shitumbanuma.
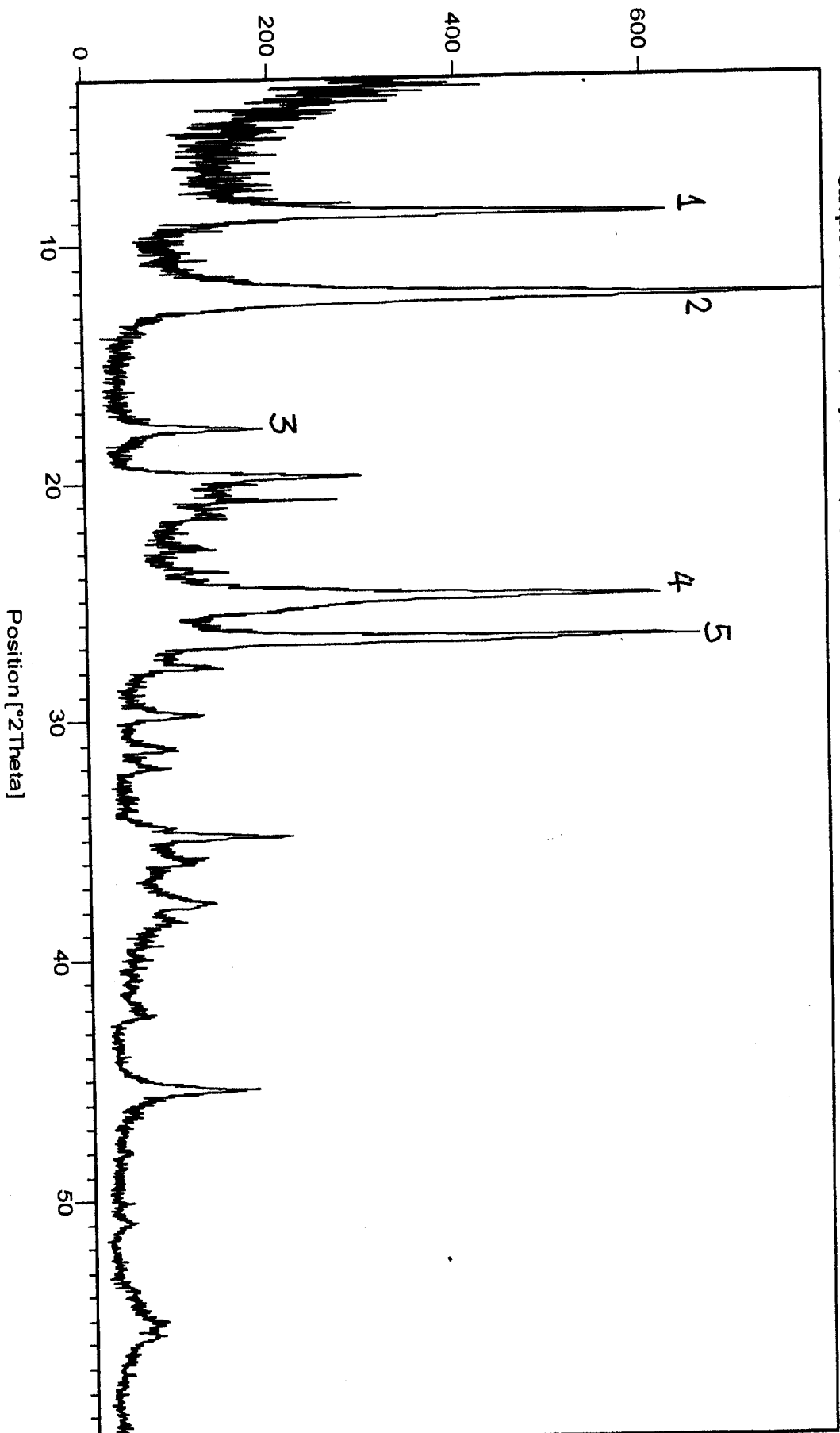
UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS-NOVEMBER, 2009

AGS 441: AGRICULTURAL HYDRAULICS AND HYDROLOGY

Time: Three (3) Hours   **Total Marks:** 100
Instruction: Answer all Questions, Appendix tables provided

---

1. Give a brief definition of the following terms   *(20 marks)*

   a) Viscosity
   b) Pressure head
   c) Energy Grade Line (EGL)
   d) Return Period
   e) Cavitation

2. You are the supervisor on a job tasked with building a detention pond to store water for irrigating a large swath of cropland. The detention pond will be constructed by removing soil from the high end of slope to build the wall at the downhill end of the slope (*see Figure below*). It is expected that the maximum depth (d_{max}) of water in the pond will be 3 meters. The soil is clay loam with a density of 1.28 g/cm^3.*(15 marks)*
   Determine the following:
   a) the magnitude (expressed in kN/m) of the hydrostatic force (F_{hyd}) acting on the wall
   b) the magnitude of the horizontal force (expressed in kN/m) imparted to the soil by cohesion
   c) the distance along the face of the wall (from the surface) to the center of hydrostatic pressure? (NOTE: You may assume b = 1.0 m)
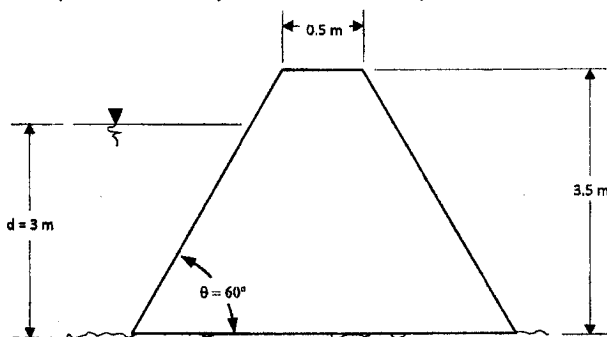
HELPFUL HINT: $\Delta y = \dfrac{bh}{Ay_c}$

3. A 0.4m diameter well fully penetrates an aquifer with a coefficient of permeability of 10^{-3} m/s. With a pump at a head of 40m the steady state drawdown at 8m and 10m were observed to be 2.5m and 0.6m respectively.
   (15 marks)

   Determine:
   a) Steady state discharge from the well (m/s)
   b) Impeller diameter of the pump
   c) Transmissivity (m^3/s)

4. A 500-m long pipe is 50 m higher at the entrance point and 20 m higher at the exit point than the reference level. The pipe diameter is constant (0.2 m). The velocity in the pipe is 10 m/s. The pressure at above the tank the exit point (where the pipe "daylights") is atmospheric pressure. *(15 marks)*
   Determine the following:
   a) the head loss in the pipe (expressed in meters)
   b) clearly describe at least three of the four losses that will add up to your answer for (a)
   c) sketch the hydraulic grade line (HGL) and energy grade line (EGL) for this system
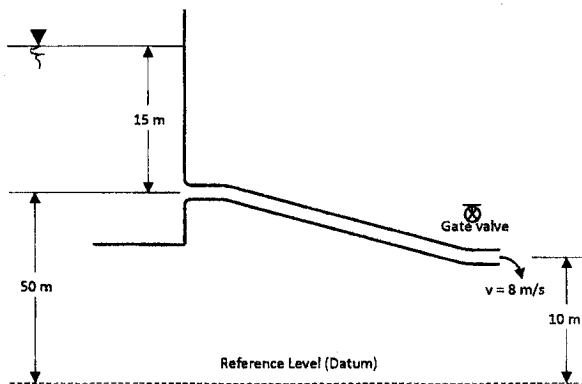
5. You are in charge of designing runoff conveyance system from a 50-hectare watershed with the following land uses and soil groups: *(15 marks)*

Area (hectares)	Land Use	Runoff Coefficient
10	Pasture, Flat, Tight Clay	0.45
20	Cultivated Land, Flat, Tight Clay	0.63
20	Woodland, Rolling, Tight Clay	0.72

Determine the following:
   a) Use the Rational Method ($Q = kCiA$) to determine the peak flow rate of runoff after a storm event with an average intensity of 100 mm/hr. Express your answer in m^3/s. NOTE: The Rational Method was developed in English Units, so a conversion factor is necessary to calculate the metric equivalent (k= 0.00278). Area units (A) are hectares. Intensity units are in mm/hr.
   b) Explain how you could estimate the hydrologic travel-time of the runoff in the watershed.
   c) Design an earthern channel cross-section (3:1 side slopes; maximum depth of 0.5 m) to convey this runoff at a maximum slope of 1.3%. Assume a Manning's Roughness Coefficient (n) equal to 0.035.

$$\text{Mannings Equation: } Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}}\sqrt{S} \quad \text{(SI Units)}$$

6. Describe the following aspects of the Green-Ampt approach to calculating soil infiltration: *(20 marks)*
   a) Explain the three primary assumptions of the Green-Ampt approach.
   b) Describe the three basic soil parameters needed to calculate soil infiltration using Green-Ampt. (RECALL: these parameters are θ_e (or alternatively η) ψ, and K.
   c) How would you expect infiltration (as calculated using Green-Ampt) to change with increasingly negative matric potential in the soil?
   d) How would you expect infiltration (as calculated using Green-Ampt) to change with increasing storm duration?

End of Exam

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS: NOVEMBER 2009

AGS 531: LAND EVALUATION AND IMPROVEMENT

INSTRUCTION: Answer all questions   **TIME:** 3 Hours

1. There are several main land uses in Zambia.
a) Mention two of the most widespread land uses in Zambia.   (2 marks)
b) State three environmental impacts associated with each of the stated land uses in a.
(6 marks).
c) What mitigation measures are possible for each of the impacts mentioned in b above?
(5 marks)

2. A number of qualitative and quantitative methods are available for use in evaluating land suitability.
a) What are the conditions applicable if a land unit is to be evaluated under the Zambian Land Capability System?   (5 marks)
b) What are the advantages and disadvantages of using the Storie Index in assessing land suitability? (5 marks)

3. Define the following terms as used in land evaluation:
a) Landform (3 marks)
b) Land tenure (3 marks)
c) Land utilization type (3 marks)

4. a) Why should the scale and level of decision making be clearly defined prior to land evaluation. (5 marks)
b) List the basic information that should be included in the terms of reference (TOR) for a land evaluation project. (5 marks)

5. a) Why are the site factors included in the Land Evaluation and Site Assessment model (LESA) when assessing land suitability? (4 marks)
b) Why is the Land Evaluation and Site Assessment model (LESA) said to be an objective system for assessing land suitability? (4 marks)

6. Mention at least five land characteristics that can be measured to estimate each of the following land qualities.
a) Soil Workability (5 marks)

b) Nutrient availability (5 marks)
c) Erosion hazard (5 marks)

7. Given the land unit shown in annex 1 below;
a) Determine its land suitability class using the USDA Land Capability Classification System. (7 marks)
b) What are the limitations and potentials of this land unit? (7 marks)

ANNEX 1

Profile number: KF3
Physiography: lower slope
Parent material: Alluvium
Erosion: slight sheet
Soil permeability: slow
Vegetation: acacia mostly cleared
Described by:

Date: 2/10/2007
Location: Kafue   STR: Isohypethermic.
Slope: 2% (linear)   Surface cracking present
Natural drainage class: well drained
Erosion: Slight
Land use: Fallow   Classification:

Ap 0 -20cm: Brown (10YR5/3) dry to dark brown (10YR3/3) moist; sandy clay loam; few fine distinct reddish yellow (7.5 YR6/6) mottles, fine to medium sub-angular blocky; hard, slightly sticky, slightly plastic, common fine manganese concretions, fine cracks, weak reaction to HCl and clear smooth boundary.

Btc1 20– 60 cm: Yellowish red (7.5 YR6/6) dry to dark yellowish brown (10YR4/6) moist; clay loam; few fine distinct reddish yellow (7.5 YR6/6) mottles, medium to fine sub-angular blocky; hard, sticky, plastic, common fine manganese concretions, fine cracks, weak reaction with HCl; clear smooth boundary.

Btc2 60 – 110+cm: Light yellowish brown (2.5Y6/4) dry to light brown (2.5Y5/4) moist. ; Clay loam; medium weak sub-angular block, many medium manganese concretions, weak reaction with HCl and clear smooth boundary.

Horizon	Composite	Ap	Btc1	Btc2
Depth (cm)		0-20	20 -60	60 – 110+
Clay (%)	38.4	52.4	34.4	36.4
Silt (%)	29.6	17.6	27.6	27.6
Total sand (%)	32	30.0	38.00	36
Texture class	CL	C	CL	CL
pH CaCl$_2$	7.21	6.97	6.75	7.00
O.M (%)	2.04	1.04	0.24	0.56
N (%)	0.8	0.06	0.05	0.03
P (ppm)	4.69	3.82	1.86	9.10
K (me%)	0.35	0.14	0.15	0.11
Na (me %)	0.04	0.05	0.05	0.06
Ca (me %)	10.14	8.96	6.59	6.99
Mg (me %)	1.15	1.52	1.23	1.21
Cu (ppm)	5.04	0.04	1.07	1.61
Zn (ppm)	9.78	0.37	0.39	0.36
Fe (ppm)	4.17	2.16	1.99	1.58
Mn (ppm)	11.44	9.96	11.08	5.42
CEC (me/100g)	14.27	14.40	14.07	13.33

TABLE 37 A simplified example of a conversion table for use with the USDA Land-Capability Classification. To apply the table to a land unit, examine the columns successively from left to right until a column is found in which the values given are not exceeded for any limitation. Otherwise favourable land with a severe wetness limitation is placed in Class Vw

Limitation	Arable classes				Non-arable classes			Special class
	I	II	III	IV	VI	VII	VIII	Vw
Slope angle, degrees	1	3	5	10	18	35	Any	
Outcrops and boulders, percent surface occupied	0	1	2	5	10	25	Any	2
Wetness, class	Nil	Nil	Slight	Slight	Moderate	Moderate	Severe	Severe
Soil effective depth, cm	150	100	60	30	20	20	0	30
Soil texture	SCL-C	SL-C	SL-C	LS-C	LS-Heavy C	LS-Heavy C	Any	LS-Heavy C
Soil permeability	Moderate	Rapid-Slow	Rapid-Slow	Rapid-Slow	Any	Any	Any	Rapid-Slow
Available water capacity, cm	25	20	15	10	5	2	0	10
Cation exchange capacity, subsoil, m.e./100 g	20	15	10	5	5	2	0	5
Total soluble salt, percent	0.2	0.2	0.4	0.4	0.8	1.0	Any	0.4

fertilizer. However, he further points out that he does not have enough money to pay for a full range of analysis. As a soil chemist you decide to determine only pH to help this poor farmer.

a. pH is known as one of the master variables in the soil. Explain. (2)

b. What laboratory equipment would you use to determine the chosen parameter? (1)

c. If the pH was found to be less than 5, what would immediately come to your mind as the major constraint in the soil attributable to the poor maize grain yields? Explain the negative effects of this constraint. (5)

d. How would you help the farmer to address the constraint? (2)

2. A solution contains 0.02 mol liter^{-1} of $Ca(NO_3)_2$, 0.01 mol liter^{-1} K_2SO_4 and 0.01 mol liter^{-1} NaCl.

a. Calculate the ionic strength of the solution. (5)

b. What is the single-ion activity coefficient at 298K for the calcium cation? (5)
   (A = 0.509, B = 0.33, d = 6).

3. Define (a) and Contrast the terms in (b, c, d and e). (10)

a. Lime requirement
b. Intensity factor and capacity factor of soils
c. Adsorbate and adsorbent
d. Negative adsorption and positive adsorption of ions

1

e. Reserve acidity and active acidity

4. Crystalline silicate minerals found in clay soils are normally made up of layers

   a. Indicate the two basic building blocks of layer silicates. Use labeled diagram   (4)

   b. Indicate how soil charge comes about in these structures   (4)

   c. Of what significance is the charge to fertility of a soil?   (2)

5. Oxidation and reduction reactions are considered to be very important in soils.

   a. Define redox.   (2)

   b. In 2008/3009 cropping season some parts in Zambia received above normal rainfall which resulted in flooding of fields with dire consequences of wide spread crop failure. Explain the soil conditions following flooding that could have lead to the crop failure?   (5)

   c. Draining submerged soils can make them useful for crop production by raising oxidation status. However, in the case of acid sulphate soils this is not so. Explain   (3)

6. Phosphates are one of the natural inorganic buffers occurring in soil systems.

   a. What is the meaning of a buffer?   (2)

   b. By means of equations show how phosphates buffer against the inputs of acidity (H^+) or alkalinity (OH^-) from the soil environment.   (2)

   c. Using a unified P phase diagram, show the effect of pH on the distribution of orthophosphate ions in solution.   (4)

   d. What is the preferred orthophosphate form for plant uptake and within what pH range is this form available?   (2)

7. A study was carried out on the effects of adding plant residues to acid soil. To 300 g of soil, 9 g of crop and tree residues were added and thoroughly mixed followed by addition of 45 ml of H_2O. A control without residue was included. All samples were incubated at 30°C in polythene bags that were loosely folded and occasionally opened and shaken to ensure adequate aeration. Water was occasionally added to maintain the moisture content. Sampling was done every 14 days up to 100 days and the pH of soil was determined. The figure below shows pH changes over the 100 days for the various treatments.
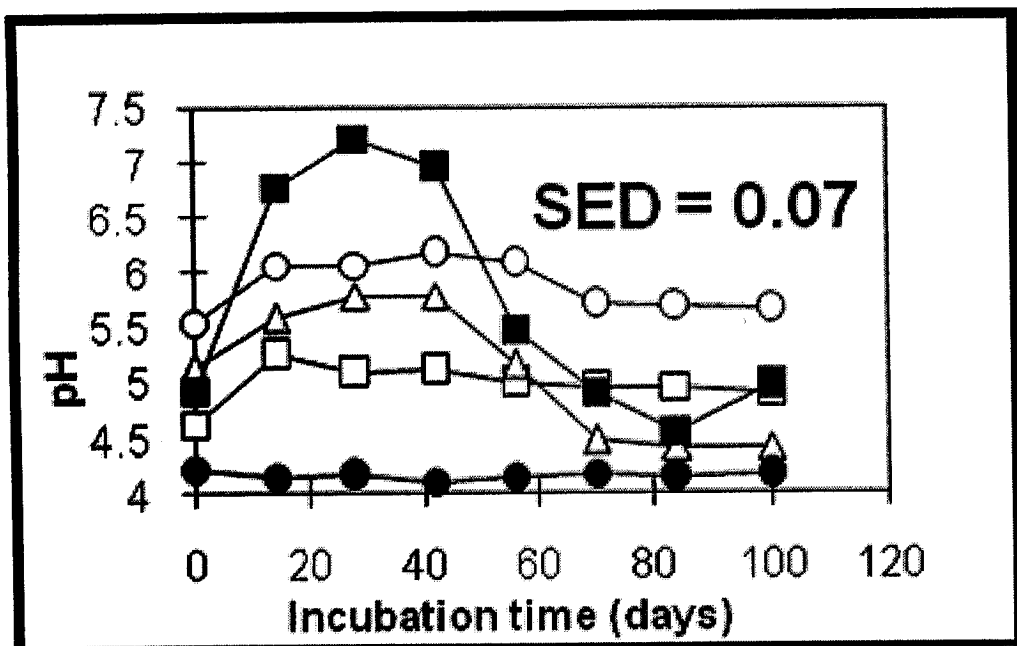
Key: □:Maize, ■:Gliricidia, O: Soybeans, ●:Control, △: Leucaena

Based on the above Figure answer the following questions:

a. Compared to the control (pH 4.2), which plant residue had the largest pH change? Give an estimate of this change in pH units. (2)

b. During which incubation interval (0-10, 20-40 or 60-100 days) would you expect the lowest pe to be recorded in the treatments amended with plant residues? Give reasons to support your answer. (2)

c. If the instantaneous pH changes at the beginning of incubation are ascribed to ligand exchange reactions while the changes during incubation are ascribed to nitrogen transformations, which residue had the most ligand exchange and which residue had the largest amount of nitrogen mineralized? Give reasons to support your answer. (7)

d. Explain the terms, protonation and deprotonation. During which incubation interval in the figure above would each of these processes dominate with respect to the plant residues added, and state the resulting effect on pH? (4)

END OF EXAMINATION

3

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATION
NOVEMBER 2009

EA 421
FUNDAMENTALS OF FARM STRUCTURES

TIME ALLOWED: 3 Hours

MARKS: 100

INSTRUCTIONS:
I.   Answer all questions in section **A** and any Two (2) in section **B**.
II. Use of Calculators is permitted
III. A Psychrometric chart will be provided for the question 6.

SECTION A.

QUESTION 1
A Poultry house is to be constructed on a concrete block foundation. The 200mm (8 – inches) concrete brocks are to be used. The dimensions of an 8 – inch block is shown in figure 1.

a) How many of such blocks can be produced from a volume of 1 m³ of concrete mix if a nominal mix of 1:3:5 is to be used. Experience shows that the actual volume of the concrete member would be 68% of the volume of the mix, while the material use efficiency is 97%.

(8 Marks)

b) How many pockets (50 kg bags) of cement are required

(4 Marks)

c) How Much water would you add to the mix and why?

(3 Marks)

d) The foundation was cast soon after the rain season. The moisture content of sand is 8 % while that of crushed stones is 2 %, how much water would you add to the mix in order to achieve concrete of maximum strength? The density of sand is 1.4g/cm3 and that of crushed stones is 1.6g/cm3.

(6 Marks)

e) Establish the aggregate – cement ratio

(4 Marks)

y

NOTE: The shaded section represents the void.

SECT X-X

130   130

400

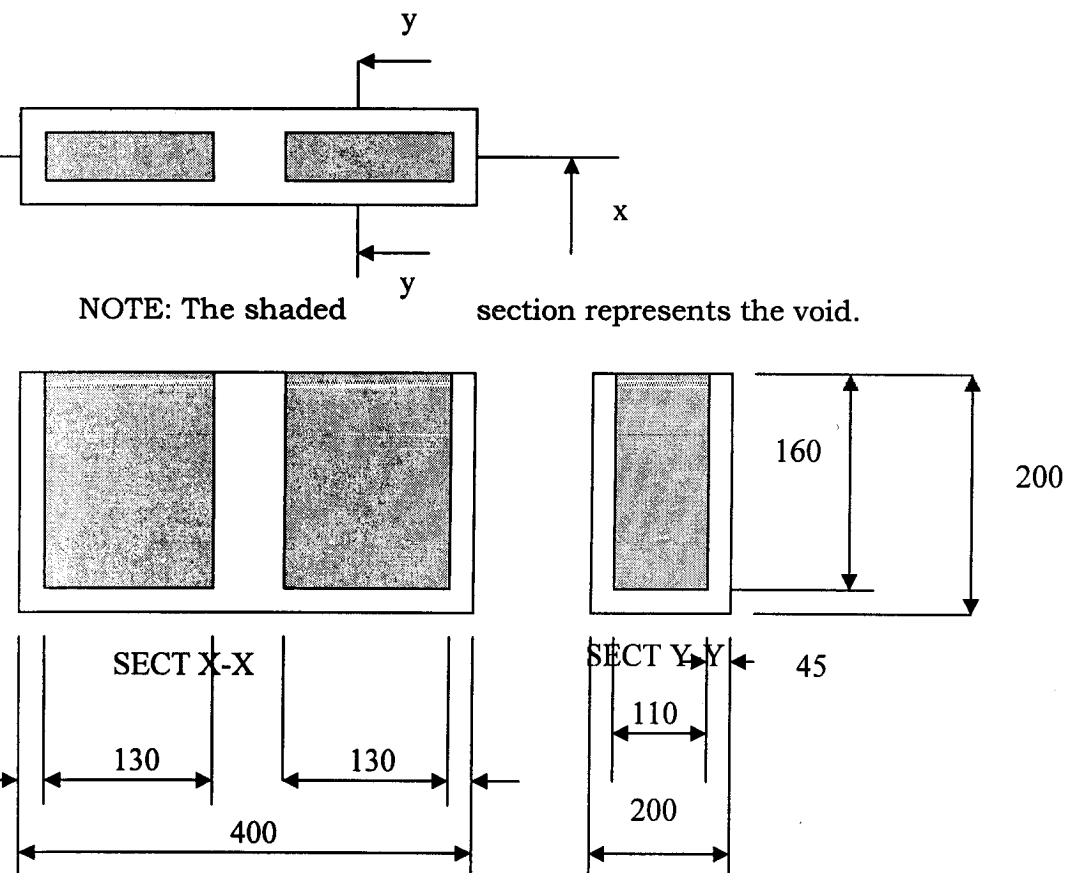SECT Y-Y   45

160

200

110

200

Figure 01: An 8-Inches Concrete Block

QUESTION 2

The poultry house in question 1 above has the following dimensions:

Length = 9 m
Width = 5m.

It is be roofed with claddings that have the following specification:

C.S. 10/100:
Length = 3 m,
Width = 100 cm

The recommended slope of the roof is 1:3

a) What kind of the roof would you recommend, why?

(5 Marks)

b) How many roofing units are you going to require if the following is the case:

Roof overhang = 80 cm,
End lap = 100mm &
Side lap = 2 corrugations

(6 marks)

c) Discuss the merits and demerits of the GCSS over the other roofing sheets.

(3 marks)

d) Describe the procedure you would follow when placing roofing sheets on the given roof (figure 2).

(2 marks)

e) How would you ensure a leak proof roof even after fixing the roof claddings?

(2 marks)

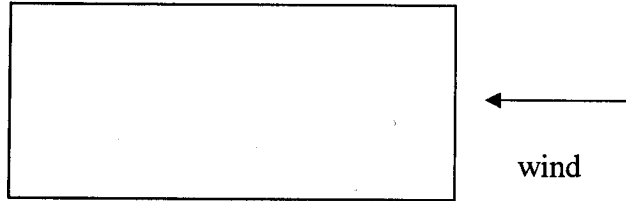f) Discuss factors influencing the slope of the roof.

(3 Marks)

Figure 2: Plan of a Roof

SECTION B.

QUESTION 3

In its quest to improve the sanitation of a district, Ventilated improved pit latrines (VIP) were introduced.

a) Discuss the operations, merits and de-merits of the VIPs with aid of a neatly labelled sketch.

(7 Marks)

b) What precautions must be observed when siting a pit latrine

(5 Marks)

c) Given a household of eight (8) and a sludge accumulation rate of 0.05 m^3/hd/year. Calculate the Volume of the pit and establish the required dimensions (pit).

(8 Marks)

d) Distinguish a pit latrine to a water-borne toilet system.

(5 Marks)

QUESTION 4:

The structure in figure 3 is fully air conditioned and only has openings in front as in figure 3. The walls are to be built using the blocks (4; 6; & 8 inches).

a) Calculate the number of blocks (of the three sizes) required to complete the four sides.
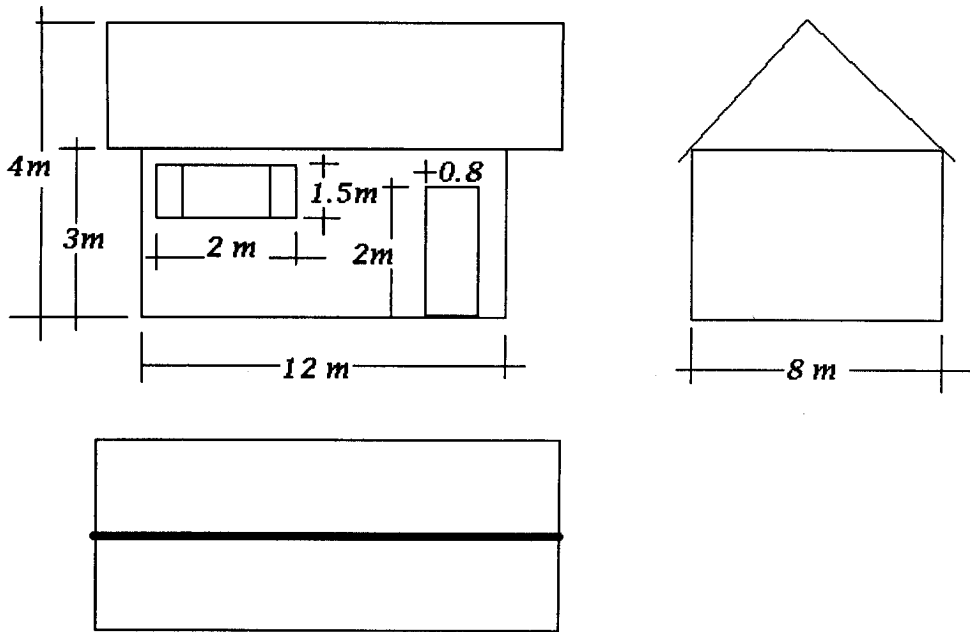
(15 Marks)

Figure 3: Structure to be built.

b) What is the significance of bonding in wall construction? Give some examples with aid of neat sketches.

(6 Marks)

c) What is mortar, what condition must it fulfil in building?

(4 Marks)

QUESTION 5:

a) Discuss factors which influence Farmstead planning

(5 marks)

b) What is the significance of Zone planning in agricultural production?

(7 marks)

c) What are the merits and de-merits of battery cage systems compared to the deep-litter floor systems (in poultry)?

(8 marks)

d) What measures would undertake to overcome some of the constraints of the battery cage system?

(5 marks)

QUESTION 6

Due to the prolonged rain season in the northern part of the Country, Maize was harvested with relatively high moisture content. To bring the moisture content to its optimum, the grain had to be dried using a centrifugal heater blower. Air was initially at a dry bulb temperature of 17° C and at a relative (RH) of 60%. This was heated to a dry bulb temperature of 50° C.

a) Using the given Psychrometric chart, determine the RH and the Enthalpy levels of the heated air.

(4 Marks)

b) If the airflow into the grain was 1.6m³/s, how much moisture would have been removed in the process, and what would be the rate of moisture removal (

$$m_{air} = \frac{Q}{V_{av}})?$$

(6 Marks)

c) What is the rate of sensible heat addition if the heated air is being pumped in at a rate of 1.6 m³/s ($m_{air} = \dfrac{Q}{V_{av}}$)?

(5 Marks)

d) With aid of a graph Illustrate Sensible heating and cooling and give examples of this application.

(4 Marks)

e) What purposes are fulfilled by Ventilation in farm structures? List two examples of the Common Ventilation types commonly used in farm structures.

(6 Marks)