THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 FIRST SEMESTER EXAMINATIONS

COURSE CODE		COURSE TITLE
AGA	211	Anatomy of farm Animals
AGA	351	Animals science for engineers
AGA	441	Introduction to Agriculture
AGA	511	Techniques in Animals Science
AGA	521	Applied Animal reproduction
AGA	531	Topics in Animal nutrition
AGC	411	Field crop production
AGC	431	Agricultural Entomology
AGC	531	Principles of weed management
AGE	211	Fundamentals of microeconomics
AGE	311	Rural sociology
AGE	411	Introduction to Agribusiness
AGE	421	Production Economics
AGE	431	Linear programming Applications for Agribusiness
AGE	511	Agricultural Organisation and Administration
AGE	531	International Agricultural markets, trade and Development
AGE	541	Agricultural project planning and appraisal
AGE	211	General microbiology (Theory paper)
AGE	211	General microbiology (Practical paper)
AGF	221	Computer Science
AGF	311	Chemical techniques in Food analysis (Theory Paper)
AEF	311	Chemical techniques in Food analysis (Practical paper)
AGF	321	Food chemistry (Theory Paper)
AGF	321	Food Chemistry (Practical paper)
AGF	341	Technical Thermodynamics
AGF	411	Food Engineering
AGF	421	Food Technology 1 (theory paper)

AGF	421	Food Technology I (Practical, Open book paper)
AGF	441	Water and Food waste treatments
AGF	511	Unit operations of food Engineering II
AGF	531	Technology of plant products I
AGF	541	Technology of Dairy and Egg Products
AGS	211	Fundamentals of soil science I
AGS	431	Soil mineralogy and macro morphology
AGS	441	Agricultural hydraulics and hydrology
AGS	511	Soil Chemistry
AGS	551	Planning and development of irrigation and drainage systems

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2005 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGA 211: ANATOMY OF FARM ANIMALS

TIME: **THREE HOURS**

INSTRUCTIONS: **ANSWER Question 1 and any other 3**

Q1. Fig 1 shows a schematic diagram of basic parts of a heart. The heart is a pump of the circulatory system. The circulatory system is a closed system.

a) What does 'closed system' mean? (4 points)
b) Label the parts indicated on the diagram with arrows showing direction of blood flow. (10 points)
c) What type of muscle is the heart made up of? (2 points)
d) Describe this muscle (5 points)
e) What is a portal system? Give an example of a portal system. (6 points)
f) Which part of the nervous system enervates the heart? (3 points)
g) Describe origin and structure of this part of the nervous system. (10 points)

Q2. Fig 2 is an illustration of the upper and lower respiratory tract of a cow.

a) What are the functions of the respiratory system? (4 points)
b) Name the parts indicated on the diagram. (7 points)
c) Describe the muscular control of the respiratory process (9 points)

Q3.Male and female reproductive systems serve to perpetuate the species through complementary roles. Fig 3 is an illustration of a part of the reproductive system.

a) Name the reproductive organ indicated in the diagram. (2 points)
b) Label the parts of the organ indicated in the diagram. (8 points)
c) What is the difference between castration and vasectomy? (4 points)
d) With an illustration describe the oviducts. (6 points)

Q4. Write short notes on the structures of any 4 of the following (5points each):

a) Tubulo alveolar gland
b) Lymph nodes
c) Salivary glands
d) Areolar or loose connective tissue
e) Classification of epithelial tissue
f) Forestomach

Q5. Hormones control body functions. Hormones are secreted by the endocrine glands.

a) Name the hormones secreted by the anterior pituitary glands. (8 points)
b) Describe the pancreas, list the hormones it produces describing their functions. (12 points)

Thank you for being in my class and Good luck

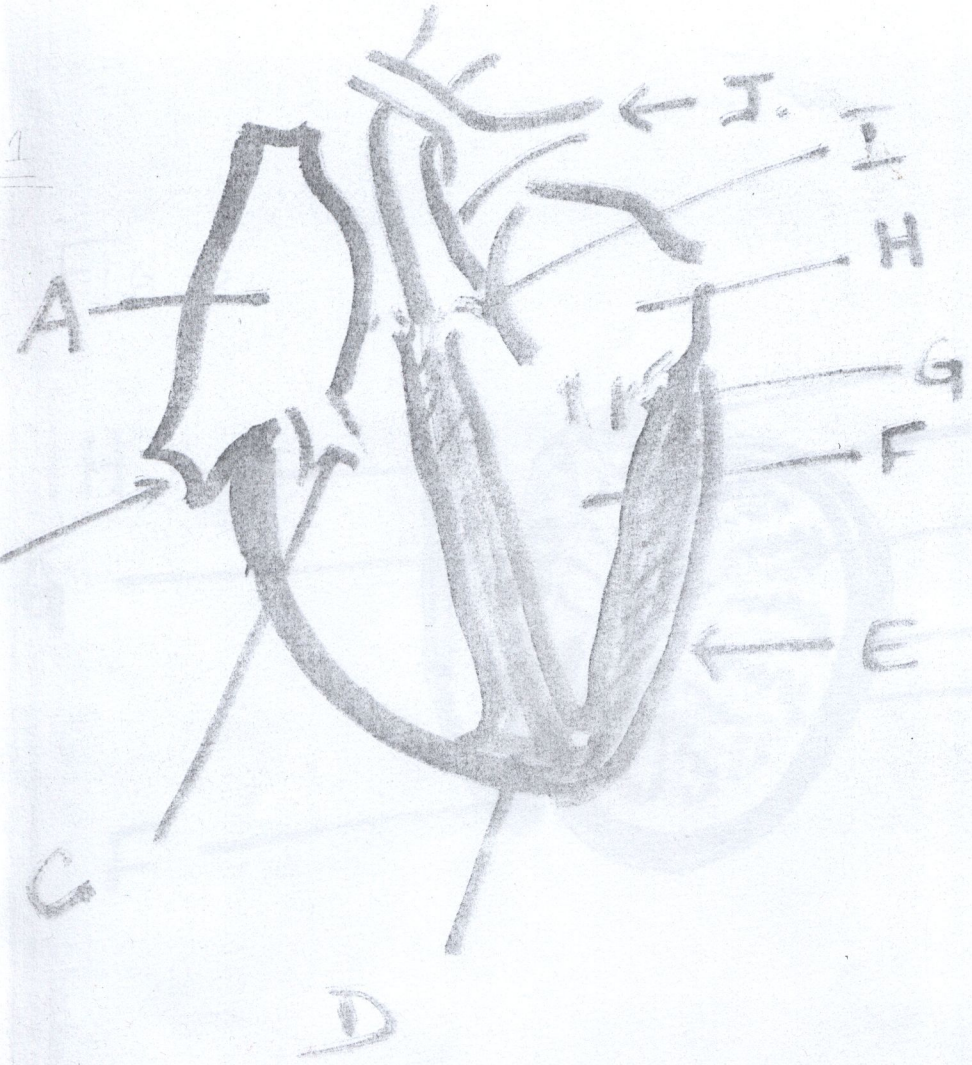


FIG 2

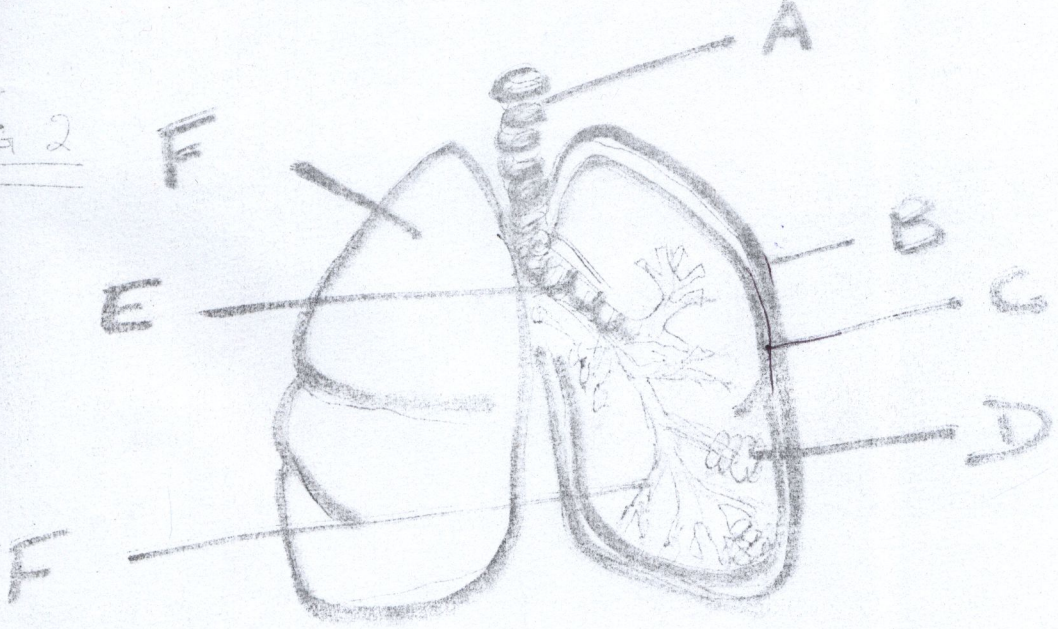
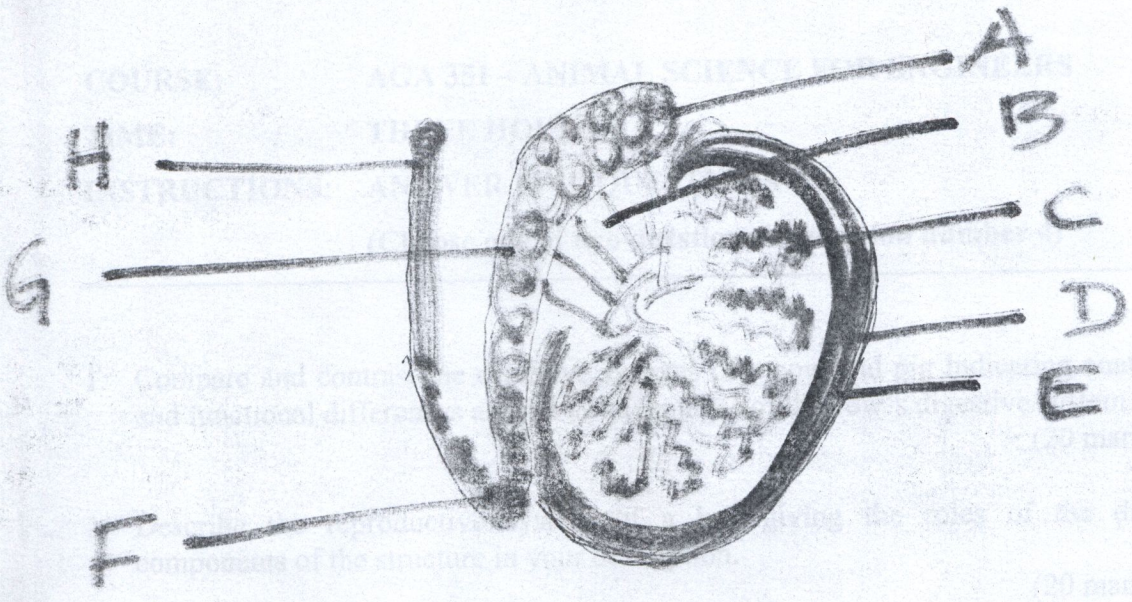


FIG 3



THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER

FINAL EXAMINATIONS

COURSE: AGA 351 – ANIMAL SCIENCE FOR ENGINEERS

TIME: THREE HOURS

INSTRUCTIONS: ANSWER FIVE QUESTIONS

(Choose one of two questions in question number 4)

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1. Compare and contrast the digestive systems of a cow and pig indicating anatomical and functional differences as well as advantages of the cow's digestive system.
(20 marks)

2. Describe the reproductive system of a hen giving the roles of the different components of the structure in your description.
(20 marks)

3. Identify and discuss the anti-nutritional factors found in the following feed ingredients:
   i) sorghum
   ii) cassava
   iii) soyabean
   iv) cotton seeds
(20 marks)

4. Discuss;
   i) the process of managing layer chicks to six weeks of age
   OR
   ii) the process of managing piglets to weaning age.
(20 marks)

5. Describe the following:
   i) the various operations normally carried out on calves in modern/commercial cattle production systems
   ii) the milking process in a modern/commercial dairy enterprise.
(20 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
END OF FIRST SEMESTER EXAMINATIONS – JUNE 2005

AGA 441: INTRODUCTION TO AQUACULTURE

TIME ALLOWED: 3 HOURS

INSTRUCTIONS TO CANDIDATES: ANSWER FIVE OF THE FOLLOWING QUESTIONS

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1. Explain the functions of the following organs in a teleost fish.

   i. Swin bladder
   ii. Pseudobranch
   iii. Paired fins
   iv. Lateral line
   v. Pyloric ceaca.

2. Compare the life cycles of *Penaeus monodon* and *Macrobranchium rosenbergii* subjected to artificial spawning. Give a brief explanation of four characteristics that favour the rearing of *Penaeus monodon*.

3. Distringuish between an open and closed system of live fish transportation. Give an account of four key factors influencing survival of fish during transportation.

4. With the aid of clearly labeled diagrams, describe the life stages of Pacific salmon (Oncorynchus kisutch).

5. What are the characteristics that favour the rearing of Chinese carps. What role does each of the four (main) species play when reared in a polyculture system of fish farming?

6. Discuss the advantages of rearing an all male stock of *Tilapia mossambicus*? Explain three methods of obtaining mono-sex fingerlings in a named Oreochromis species.

7. Over the past three decades, per capita consumption of fish in Zambia has declined from 16.5 kg/person/yr to 6.3 kg/ person /yr. What options are there for stopping the decline? Discuss each option in terms of its potential to reverse the per capita consumption decline.

THE END

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS – JUNE/JULY 2005
AGA 511 – TECHNIQUES IN ANIMAL SCIENCE

TIME: 3 HOURS

INSTRUCTIONS: ANSWER QUESTION 1 AND FOUR (4) OTHERS. ANSWER AT LEAST ONE (1) QUESTION FROM EACH SECTION. QUESTIONS FROM EACH SECTION SHOULD BE ANSWERED IN SEPARATE ANSWER BOOKS.

SECTION A

1. An animal nutritionist conducted a research to test the effectiveness of different sources of feed proteins on daily weight gains of pigs. He randomly chose four (4) litters of normal (not runts) piglets for the study. The litters were considered as **blocks.**

   The four sources of feed proteins were:
   - Chick pea
   - Soybean cake
   - Locusts
   - Chisense

   The control feed was the commonly used pig feed from National Milling Company. The average daily gains for the four feed-types are presented in the table below:

Treatment (feed conce-ntrate base)	BLOCK			
	1	2	3	4
Chick pea	25.0	28.0	22.0	23.0
Soybean	31.0	35.0	26.0	28.0
Locusts	30.0	34.0	36.0	33.0
Chisense	28.0	38.0	31.0	37.0

a. state the null hypothesis

b. Do the Analysis of Variance to test whether there are differences among the feeds with different protein sources

c. Show how you would make the following comparisons:

i) Check versus all the other feeds
ii) Soybean versus Locusts and achisense
iii) Soybean and Locusts versus Check and Chisense

2. a. What is the value of Statistical Data Analysis in Research?

b. How are multifactor experiments superior to single factor experiments?

SECTION B

3. Upon graduation you are offered employment by a company which would like you to assist in the establishment of a dairy cattle rearing farm for the purpose of producing milk, as well as fattening steers. Write on ten (10) factors that you would consider when designing the enterprise to ensure its successful operation.

4. a. Zambia has developed its own pig, poultry and dairy cattle feed standards and specifications. Write on any five (5) specifications and/or regulations for either pig or poultry feeds presented in the Zambia Bureau of Standards (ZABS) Feed Specifications of 2000.

b. Describe methods of sampling that you can apply to obtain a representative sample of maize meal for laboratory analysis.

SECTION C

5. a. Describe body condition scoring (BCS) of dairy animals. Why is BCS necessary?

b. What are the advantages of female animals over oxen as a source of Animal Draft Power (ADP)?

c. Briefly discuss the effect of work on requirements for protein, energy, vitamins and minerals of draft animals.

SECTION D

6. a. The digestibility of herbage determines the performance of ruminant animals.

   a. Discuss the possibility of using the Acid Detergent Fibre (ADF) as described in the Peter van Soest method to estimate the degradability of forages.

   b. Describe differential leucocyte (WBC) count. What information can you get from this analysis?

7. a. What is blood and why is its analysis important in livestock?

   b. Describe one method of collecting blood from cattle.

   c. Discuss the methods used to estimate the digestibility of forages in the laboratory

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END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS – JUNE 2005
AGA 521 – APPLIED ANIMAL REPRODUCTION

TIME: **3 HOURS**

INSTRUCTIONS: **ANSWER ANY FIVE (5) QUESTIONS. QUESTIONS FROM EACH SECTION SHOULD BE ANSWERED IN SEPARATE ANSWER BOOKS**

SECTION A

1. Give the treatment schedule, with dates, for synchronizing estrus to July 30 in a herd of lactating cows with a progestagen implant and estrogen-progestagen injection. What management technique could be employed to increase the degree of synchronization most effectively?

2. Give the basic physiological explanation for each of the following. Only one short explanation is needed, but be complete by following the events to completion; such as, lack of ovulation was due to a lack of LH secretion by the anterior pituitary gland. It is important to demonstrate your depth of knowledge of endocrine, neural and/or anatomical function in each case.

   a. With standard management practices sows that ovulate during lactation are selected against.
   b. A cow was seen bleeding four (4) days after estrus
   c. A ewe did not show heat with the first ovulation at the start of the breeding season.
   d. A cow with retained pyometra (uterus infection) has not been in heat for 45 days
   e. A cow suckling 2 calves has not shown heat since calving 90 days ago. Nutrition has been optimum for the past year.

3. a. Most cows do not return to estrus until 45+ days post- partum. This seems to be a built-in factor for successful gestation. What are the uterine changes taking place during this post-partum period?

   b. What factors other than uterine may delay the first post-partum estrus longer than 45-60 days?

4. a. Discuss factors that affect the degree of fertility in sows.

   b. How many piglets would you expect a sow with 20 ovulations to have at farrowing? Show how you arrive at your answer.

SECTION B

5. Insemination is considered the most successful tool contributing to development of the livestock industry.

   a. List 4 advantages of Artificial Insemination.

   b. What are the properties of a good semen diluter?

   c. You have been provided with 2 ml of bull semen whose motility is 80%, sperm concentration is 1000 x 10^6 sperm/ml and normal sperm rate is 70%.

   i) Determine dilution rate for liquid semen
   ii) Determine dilution rate for frozen semen

6. Profitability of a livestock enterprise is determined by the reproductive efficiency of the animals.

   a. What are the effects of heat stress on reproduction in livestock?

   b. How can you reduce the effects of heat stress on cattle?

   c. What are the physiological and psychological causes of reproductive failure?

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

END OF FIRST SEMESTER EXAMINATIONS – JUNE 2005

COURSE AGA 531 - TOPICS IN ANIMAL NUTRITION

TIME ALLOWED: THREE HOURS ONLY.

INSTRUCTIONS TO CANDIDATES:

a) ***Answer Question 1, and any three (3) others.***

Q. 1 Formulate a broiler ration for the third phase feeding in the three-phase feeding programme for a broiler farmer who wishes to use of the locally available feed ingredients. The broiler ration should contain 3,200 Kcal/kg ME, 20% DCP, 1% lysine, 0.6% Methionine, 1.0% Calcium, 0.75% Phosphorus, 1% Broiler (Vitamin and Mineral) Premix and 1.0% Salt.

The following feed ingredients are available:

INGREDIENT	COMPOSITION					
	ME (Kcal/kg)	CP%	LYS%	METH%	Ca%	P%
Maize Meal	3450	8.8	0.24	0.20	0.02	0.28
Soyabean Cake	2350	44.0	2.93	0.63	0.29	0.65
Tallow	8000	-	-	-	-	-
Dicalcium Phosphate	-	-	-	-	26.0	18.0
Limestone Flour	-	-	-	-	38.0	-

(40 Marks)

Q. 2 Formulate a ration for beef cattle, with the help of the Pearson Square, containing 13.5% DCP and 75% TDN which must include 15% Natural Grass/Stylo Hay, 10% Maize Bran, 4% Sugarcane Molasses, 5% Soyabean Straw and 2% slack space for mineral supplement, on dry matter basis. The table below may be used to answer the question.

Feed analyses (on dry matter basis, i.e. moisture free):

FEED	DM%	DCP%	TDN%	Ca	P
Natural grass/Stylo	92	22.5	58	1.90	0.20
Maize bran	90	12.5	70	0.07	1.62
Molasses	75	-	85	1.19	0.11
Soyabean straw	85	25.0	65	0.69	0.06

Other feeds available are:

Maize meal	89	10.0	88	0.03	0.31
Groundnut meal	95	55.0	90	0.18	3.62
Groundnut haulms	87	2.0	62	0.07	0.17
Lucerne hay	90	85.0	60	0.27	0.03

(20 marks)

Q.3 a) A 530 kg Holstein dairy cow in mid-lactation (no weight change) eats 25 kg ***Chloris guyana*** (Rhodes Grass) and produces 20kg milk containing 3.8% butterfat and 8.8% solids-not-fat per kg. How much concentrate mixture (2:1:1:1) consisting of Corn and Cob Meal : Meat Meal : Fuzzy Cotton : Molasses will she need to eat to provide sufficient energy to maintain her body weight?

The following may be used to answer the question: -

	DM (g/kg)	ME (MJ/kg DM)
Rhodes Grass	300	8.5
Corn and Cob Meal	96	12.0
Meat Meal	96	13.0
Fuzzy Cotton	92	10.0
Molasses	77	14.5

b) If the 530kg Holstein dairy cow in a) above was in early lactation and was actually losing 0.5kg per day, how much concentrate mixture will she need to eat to maintain her body weight?

c) If the 530kg Holstein dairy cow in a) above was in late lactation and was actually gaining 0.5kg per day, how much concentrate mixture will she need to eat to maintain her body weight?

d) Calculate the rations that meet both dry matter appetite and energy allowances using the rapid formulation of forage and compound feed rations, given that the forage and the concentrate energy concentration of the ration (M/D) in a) above.

(20 Marks)

Q. 4 Write notes on the following:

a) The symptoms of Calcium deficiency in ruminants. Discuss the predisposing factors and symptoms of hypocalcaemia or milk fever in dairy cattle (10 Marks);

b) Cyanogenetic glycosides and glucosinolates (5 Marks); and

c) The advantages and disadvantages of the fore-stomach fermentation as opposed to hind gut fermentation (5Marks).

(20 Marks)

Q. 5 Answer the following:

a) How much is a Boran steer weighing 355kg expected to grow if it is fed on daily ration consisting of the following feed-stuffs: -

9.5 kg Maize Silage (300 g/kg DM, 8.6 MJ ME/kg DM)
7.5 kg Maize Meal (850 g/kg DM, 12.5 MJ ME/kg DM)
2.5 kg Cane Molasses (270 g/kg DM, 13.0 MJ ME/kg DM)

b) Calculate the True Biological value of a protein supplement from the data given below:

- Dry matter feed consumed daily (grams) = 8.50
- Percent nitrogen in the feed, dry matter basis (dmb) = 2.196
- Daily urinary output (mls) = 20.50, containing
  - 0.00486g total nitrogen per ml, and
  - 0.0025g endogenous nitrogen per ml.
- Daily dry matter faecal output (grams) = 6.40, containing
  - 3.82 mg total nitrogen per gram, and
  - 2.75 mg metabolic faecal nitrogen per gram, dmb.

(20 Marks)

The following may be used to answer any questions:

i. $Mm = 8.3 + 0.091\ W$

ii. $DMI = 0.025\ W + 0.1\ Y$

iii. $Eg = \dfrac{MEP \times 0.0435\ M/D}{1.05}$

iv. $EVI = 0.0386\ BF + 0.0205\ SNF - 0.236$

v. $LWG = \dfrac{Eg}{6.28 + 0.3\ Eg + 0.0188\ W}$

vi. $FD = \dfrac{DMI\ (MC - M/D)}{(MC - MF)}$

vii. $MI = \dfrac{EVI \times 1.05}{0.62}$

viii. $KI = \dfrac{0.0435\ M/D}{1.05}$ or $0.0414\ M/D$

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP SCIENCE

1ST SEMESTER EXAMINATIONS – JUNE 2005

AGC 411 – FIELD CROP PRODUCTION
TIME ALLOWED: Three (3) hours
INSTRUCTIONS: Answer all Questions
Marks for each Question are as Indicated

Q1. A farmer in Lundazi has been contracted by Clarke Cotton to grow cotton. She has been advised to investigate for pests before spraying. As an expert in this crop, prepare a scouting guide for the farmer. **(20 marks)**

Q2. A group of small scale farmers in Kabwe would like to grow wheat for the first time. As a newly appointed agricultural officer, advise the farmers on the following:-

a. Significance of the crop.
b. Soil and climatic requirements
c. Planting date
d. Seed rate and spacing
e. Fertilizer recommendation
f. Expected yield. **(25 marks)**

Q3. A Young Farmers' Club has grown maize and sunflower. Give advice on considerations to be taken when deciding to harvest each of these crops, how they are harvested and the expected yields per hectare. **(25 marks)**

Q4. A farmer suspects the following in his fields:

a. Shootfly – sorghum
b. Rosette – groundnuts
c. Streak – maize.

As an upcoming entomologist/pathologist, what evidence do you need to confirm each of these and what would be your advice on the control/prevention of these diseases and pest to the farmer? **(20 marks)**

Q5. Describe pegging in groundnut production. **(10 marks)**

END OF EXAM

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF CROP SCIENCE

FIRST SEMESTER **FINAL EXAMINATIONS** **JULY 2005**

AGC 431: AGRICULTURAL ENTOMOLOGY

TIME: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS,
ALL QUESTIONS CARRY EQUAL MARKS (20 Marks each)

Q1. Define metamorphosis and explain the different types of metamorphosis in insects.

Q2. Compare and contrast the female and male reproductive systems of insects.

Q3. Define biological control and outline the various methods of biological control. Discuss the advantages and disadvantages of this method.

Q4. What is legislative control? Discuss in detail the functions of a Plant Quarantine Division.

Q5. Define integrated pest management and outline the principal components of this programme.

**********END OF EXAMINATION**********

UNIVERSITY OF ZAMBIA
DEFFERED UNIVERSITY EXAMINATIONS, JULY 2005

AGC 521 ADVANCED PLANT BREEDING

INSTRUCTIONS
Answer question **ONE** and any other **THREE**. Marks for each question are indicated in brackets
TIME: 3 hours

Q.1 (a) Diallel mating is one of the mating designs used in estimating genetic parameters. Outline how an experimental population is created through this design. Explain when a fixed model and a random model should be used. (15 points)

(b) Given the following data from a backcross breeding program estimate broad and narrow base heritabilities.

	Parent 1	Parent 2	F_1	F_2	BC_1	BC_2
Means	12.99	27.61	18.45	21.20	15.63	23.38
Variances	11.036	10.320	5.237	40.350	17.352	34.288

It is also given that $V_{F2} = V_A + V_D + V_E$; $V_{BC1} + V_{BC2} = V_A + 2V_D + 2V_E$ and $V_E = (V_{P1} + V_{P2} + V_{F1})/3$. The term V depicts the variance of respective term. (25 points)

Q.2 Outline the proofs for the Hardy-Weinberg-Law. One of the applications of the Law involves the testing of observed genotype frequency if it is in equilibrium. Given the following: In a population whose genotype numbers are AA =233, Aa = 385 and aa = 129 determine the gene frequencies and test the hypothesis that the genotype frequencies are not in equilibrium. Interpret the results. (20 points)

Q.3 Write short notes on the following (4 points each):
a. Genepool
b. Fitness
c. Uses of polyploidy in plant breeding
d. Ex-situ conservation
e. Conditions under which Hardy-Weinberg Law holds

Q.4 What is evolution and what forces operate it? Explain the Neo-Darwinian Evolutionary Theory. What do you understand by Centers of Origin and Centers of Diversity? (20 points)

Q.5 Why did you learn as to the purpose of a Genebank? Why was it established? What are the major functions of such a facility? Of what relevance is it to current crop improvement programs in Zambia? Discuss citing relevant examples in Zambia. (20 points)

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP SCIENCE

Principles of Weed Management: AGC531
Final Examination.

Date: 6th July 2005
Time allowed: three (3) hours

Instructions.

Answer question 1 as it is compulsory and three other questions. Points for each question are indicated.

Compulsory

Q1. 30 points

a) Define a weed from the perspective of an ecologist, an enthusiastic amateur and an agronomist giving the principles on which each definition is based.
b) Why is persistence desirable to a soil applied herbicide and what factors affect it?
c) What characteristics, individually and collectively, differentiate a weed from a crop?
d) What is an adjuvant and what is a surfactant? Give examples.
e) What are the main differences between competition, amensalism and parasitism from a weed-crop interaction standpoint?

Optional

Answer any three (3) questions.

Q2. 10 points

a) Discuss the direct losses that weeds can cause to the farming community.
b) What are the innundative and innoculative weed control methods? Give examples.

Q3. 10 points

a) Discuss the factors that determine competitiveness of a plant.
b) Discuss herbicide applications based on when they are applied and where they are applied.

Q4. 10 points

a) Differentiate the concepts of weed control, weed management and weed eradication.
b) List ten (10) weeds common in Zambia from ten (10) different families.

Q5. 10 points

a) Define cultural weed control and list out the various components of this method.
b) Why is the zamwipe and integral part of weed management in conservation farming?

End of Examination

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGE 211: FUNDAMENTALS OF MICROECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER Questions 1, 2 and 3, and any other two
Marks: 100 Total (each question carries 20 marks)

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(1) Do you agree or disagree with each of the following statements? Briefly explain your answers.

(a) Two normal goods cannot be substitutes for each other.
(b) The midpoint formula is more accurate in measuring elasticity between two points.
(c) If the income effect of a wage change dominates the substitution effect for a given household, and the household works longer hours following a wage change, wages must have risen.
(d) A profit maximizing monopolist equals MC = MR = P.
(e) The least cost combination occurs when

$$\frac{MU_L}{MU_K} = \frac{P_L}{P_K}$$

(2) (i) Suppose that the price of football tickets at UNZA is determined by market forces. Currently, the demand and supply schedules are as follows:

PRICE	QUANTITY DEMANDED	QUANTITY SUPPLIED
K4	10,000	8,000
8	8,000	8,000
12	6,000	8,000
16	4,000	8,000
20	2,000	8,000

(a) Draw the demand and supply curves. What is unusual about the supply curve? Why might this be true?
(b) What are the equilibrium price and quantity of tickets?

(ii) Suppose that your demand for compact discs is as follows:

PRICE	QUANTITY DEMANDED (Income = K10,000)	QUANTITY DEMANDED (Income = K12,000)
K8	40	50
10	32	45
12	24	30
14	16	20
16	8	12

(a) Use the midpoint method to calculate your price elasticity of demand as the price of compact discs increases from 8 to K10 if :
(i) Your income is K10,000 and
(ii) Your income is K12,000

(b) Calculate your income elasticity of demand as your income increases from K10,000 to K12,000 if ;
(i) The price is K12 and
(ii) The price is K16

(c) Explain the meaning of the coefficients you have calculated above. What is the major advantage of using the mid-point formular?

(3) A commercial fisherman notices the following relationship between hours spent fishing and the quantity of fish caught:

HOURS	QUANTITY Kilograms
0	0
1	10
2	18
3	24
4	28
5	30

(a) What is the marginal product of each hour spent fishing?
(b) Use these data to graph the fisherman's production function. Explain its shape.
(c) The fisherman has a fixed cost of K10. The opportunity cost of his time is K5. per hour. Graph the fisherman's total cost curve. Explain its shape.
(d) Explain what you understand by the law of diminishing returns.

(4) A company is considering building a bridge across a river. The bridge would cost K2 million to build and nothing to maintain. The following table shows the company's anticipated demand over the lifetime of the bridge:

PRICE (Per crossing)	NUMBER OF CROSSINGS (in thousands)
K8	0
7	100
6	200
5	300
4	400
3	500
2	600
1	700
0	800

(a) If the company were to build the bridge, what would be its profit-maximizing price? Would that be the efficient level of output? Why or why not?
(b) If the company is interested in making profits should it build the bridge? What would be its profit or loss?
(c) If the government were to build the bridge, what price should it charge?
(b) Should the government build the bridge? Explain.

(5) Do you agree or disagree with each of the following statements? Explain your reasoning.

(a) For a monopolist, price is equal to marginal revenue because a monopolist has the power to control price.
(b) Because a monopoly is the only firm in an industry, it can change virtually any price for its product.
(c) It is always true that if demand elasticity is equal to –1, marginal revenue is equal to zero.
(d) Monopolistically competitive firms protect their economic profits with barriers to entry.

(6) (i) The total short-run cost function of a company is given by the equation C = 190 + 53 Q, where C is the total cost and Q is the total quantity of output, both measured in tens of thousands

(a) What is the company's fixed cost?
(b) If the company produces 100,000 units, what is its average variable cost?
(c) What is its marginal cost per unit produced?
(d) What is it's average fixed cost?

(ii) Explain what you understand by the following concepts:

(a) Marginal rate of Technical substitution.
(b) Equimarginal principle.
(c) Isoquant.
(d) Opportunity cost.
(e) Kinked demand curve.

END OF EXAMINATIONS

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2005 ACADEMIC YEAR FIRST SEMISTER FINAL EXAMINATION
AGE 311: RURAL SOCIOLOGY

TIME: THREE HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY FOUR OTHERS
TOTAL ANSWERED QUESTIONS SHOULD BE FIVE
EACH QUESTION CARRIES 20 MARKS

QUESTIONS

1. "Social inequality is the device by which rural societies ensure that the most important positions are filled by the most qualified persons." Discuss.

2. How is universal incest taboos deeply involved in the transformation of families as biological systems into social systems? Use the concepts of rules of descent and residence in your answer.

3. Identify and with at least some practical examples, fully explain FOUR characteristics that distinguish a traditional rural community from a modern urban community in Zambia.

4. With regard to gender perspectives, explain how the Zambian system of land tenure has influenced the development of agricultural resources in rural areas.

5. Weber considered bureaucracy as the model followed by all large, secular formal organizations. Based on his model discuss how the University of Zambia fits into the pattern of bureaucracy considered.

6. Critically contrast the influence of modernization and participatory theories of development on a changing rural social system. Clearly state the extent to which such influences would help or hinder change processes.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2005 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS
AGE 411: INTRODUCTION TO AGRIBUSINESS MANAGEMENT
TIME: THREE HOURS

INSTRUCTIONS: ANSWER **FIVE** QUESTIONS **ONLY**.QUESTIONS **ONE (1)** AND **TWO (2)** ARE **COMPULSORY**. EACH QUESTION CARRIES EQUAL MARKS

---

1. Mundia has been made redundant from his job as a driver with a local firm of agricultural wholesalers and intends to start a business of buying produce from local farmers and selling it to supermarkets. He intends to start on 1 July 2005 with K 2,500,000 of his savings and his van worth K 10,000,000

   - He will sell on credit to the supermarkets and he hopes that, they will pay him 50% in the month following a sale and 50% in the month after that;
   - He will have to pay cash to the farmers;
   - He will add 50% to the cost of purchases in fixing his selling prices to the super markets;
   - He does not intend to carry any stock;
   - Other information regarding expected income and expenditure for the six months is shown below

	Jul K'000	**Aug K'000**	**Sept K'000**	**Oct K'000**	**Nov K'000**	**Dec K'000**
Sales	4,000	6,000	8,000	9,000	9,000	9,000
Wages	840	840	900	900	1,050	1,050
Drawings	700	700	700	700	700	700
Advertising	500	500	500	200	200	200
Motor expenses	300	400	300	750	300	300
Other expenses	200	250	250	250	300	300

Required

a) Prepare a cash flow statement for the first six months? **(18 marks)**

b) How much overdraft should Mundia ask for? **(2 marks)**

2. Wamulume Ltd operates an agricultural store dealing in seeds and chemicals. The financial statements of the business for the year ended 30 June 2005 are as follows:

Balance sheet as at 30 June 2005

	K (Millions)	K (Millions)
Fixed Assets		
Land and buildings at cost		360.0
Fixtures and fittings at cost		87.0
		447.0
Current Assets		
Stock at cost	592.0	
Debtors	176.4	
Cash at bank	84.6	
	853.0	
Current Liabilities		
Trade creditors	271.4	
Dividends	135.0	
Corporation tax	16.0	
	422.4	430.6
Total assets less current liabilities		877.6
Long-term liabilities		
Debentures		190.0
Net assets		687.6
Capital		
Ordinary shares		320.0
General reserves		355.9
Retained earnings		11.7
		687.6

Profit and Loss Account for the year ended 30 June 2005

	K (Millions)	K (Millions)
Sales		1,478.1
Less cost of sales		
Opening stock	480.0	
Purchases	1,129.5	
	1,610.3	
Less closing stock	592.0	1,018.3
Gross profit		459.8
Less operating expenses		308.5
Net profit before interest and tax		151.3
Less interest payable		19.4
Net profit before tax		131.9
Less corporation tax		32.0
Net profit after tax		99.0
Add retained profit brought forward		46.8
		146.7
Less dividends proposed		135.0
Retained profit carried forward		11.7

Required

i) Calculate the following ratios:

a) Current ratio **(3 marks)**
b) Acid test ratio **(3 marks)**
c) Return on capital employed **(3 marks)**
d) Interest cover ratio **(3 marks)**
e) Net profit margin **(3 marks)**

ii) Comment on each of the ratios and draw up a conclusion on the financial performance of the company **(5 marks)**

3 a) List the factors one should consider in selecting the best business organizational form for an agribusiness **(5marks)**
b) Compare and contrast a limited company to a sole proprietorship **(15 marks)**.

4. Risk management is an important consideration in many agribusiness decisions today.
Discuss this statement; highlighting the types of risks faced by agribusinesses and how they can be minimized **(20 marks)**

5. Mulenga Ltd produces a range of agricultural machinery and equipment for sale to farmers. As a result of increasing demand for the business's products, the directors have decided to expand production. The cost of acquiring new plant and machinery and the increase in working capital requirements are planned to be financed by a mixture of long-term and short-term borrowing.
Required

a) Discuss the major factors that should be taken into account when deciding on the appropriate mix of long-term and short-term borrowing necessary to finance the expansion programme **(12 marks)**

b) Discuss the major factors that a lender should take in to account when deciding whether to grant a long-term loan to the business **(8 marks)**

6. Write short notes on:
a) Functions of human resources management **(6marks)**
b) Marketing functions **(4marks)**
c) Meaning of E-commerce and give three applications in agribusiness **(4marks)**
c) Features of agribusiness products **(6marks)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGE 421: PRODUCTION ECONOMICS

TIME: THREE (3) HOURS

ANSWER: ALL QUESTIONS

MARKS: 100 TOTAL (each question carries 20 marks)

---

1. a) Show graphically how the production function is related to the average and marginal productivity curves.
   b) Show the stages that portray different efficient use of resources and comment on each one of them.
   c) Which is the economic stage of production and why?
   d) Define the stages of production in terms of the elasticity of production.

2. Given the following quadratic production function and price data:

   $Y_1 = 10X_1 - X_1^2 + 30X_2 - 3X_2^2$

   Prices: $Px_1 = K4$, $Px_2 = K7$, $Py_1 = K2$, $TFC = K80$

   a) What combinations of inputs will maximise output?
   b) Derive the expansion path equation.
   c) What is the most profitable input combination on the expansion path?
   d) What is the maximum net return at this point (from C above)?

3. (a) What is the future value of three million Kwacha after 5 years if the opportunity cost is 12%?
   (b) Given an option to purchase land at K100, 000 and a contract to sell it after 6 years for K150, 000. Considering that the present bank rates are 5% per year, is it worth investing in this venture. If it is worth it, how much is the opportunity cost and how much is the profit from the piece of land?
   (c) A farmer intends to invest into a combine harvester with a life span of 4 years worth K850, 000. After 4 years he intends to sell it at K150, 000. He knows that from year 1 to year 4 the added revenue from the machine is K300, 000, K250, 000, K200, 000 and K50, 000 respectively. The rate of interest obtaining on the market is 6%. Is it worth it investing in the combine harvester?

4. You, as a Manager for Liempe farm are trying to determine how much of maize and wheat can be produced with different inputs of Nitrogen (N).

   The following are the production functions for maize (M) and Wheat (W).

   $M = 65.54 + 1.084\ Nm - 0.003\ Nm^2$
   $W = 68.07 + 0.830\ Nw - 0.002\ Nw^2$

   Where:
   Nm = Nitrogen used in maize production in kg
   Nw = Nitrogen used in wheat production in kg

   You have 100 kg of Nitrogen available for 2 hectares, one for maize and one for wheat.
   The following prices are prevailing in the market.
   Pm = maize price = K3 per kg
   Pw = wheat price = K2 per kg

   a) How much of Nm and Nw can you use?
   b) How much M and W will be produced from the levels of nitrogen in (a).
   c) Determine the value marginal products (VMP) of the two enterprises.
   d) What happens to the value marginal products when nitrogen is increased from 100 to 200 kg.

5. (a) Discuss and give examples of uncertainties associated with agricultural production in Zambia. What are the various ways of combating uncertainty on the farm?
   (b) Discuss the U – shaped nature of the long-run average cost curve.
   (c) Explain the following concepts:

   (i) Isoquants
   (ii) Ridge lines
   (iii) Expansion Path
   (iv) Equimarginal principle

END OF EXAMINATION

The University of Zambia
University First Semester Examinations – June 2005

AGE 431
Linear Programming Applications for Agribusiness

Instructions: There are two questions in this exam. Answer both questions as precisely as possible. No long paragraphs!

Time: Three (3) hours

1. Mathematical programming (MP) is a very useful decision tool in agriculture and business.
   a) Why do you think MP models are so important in business decisions?
   b) All MP models have certain essential features/components. List the features/components of MP models.
   c) Linear programming (LP) is a special type of MP. List three other types of MP models and state how they differ from LP models.
   d) In research, LP fits within the framework of the scientific research process. Explain in not more than 4 short sentences how LP fits into the scientific research process.

2. Suppose in the 2005/2006 marketing season there are three maize surplus provinces (Central, Copperbelt, and Northwestern) and four deficit provinces (Eastern, Lusaka, Southern, and Western). The Ministry of Agriculture and Cooperatives (MACO) wishes to determine the cheapest shipping plan of the excess maize supply from the three surplus provinces to satisfy the excess demand in the four deficit provinces. Unit transportation costs for different combinations of supply and demand points (US $ per tonne), maize excess supply at surplus points, and maize excess demand at demand points are summarized in the following table.

	Transportation cost ($/tonne) by deficit province				Excess supply (tonnes)
Surplus provinces	Eastern	Lusaka	Southern	Western	
Central	50	70	90	60	800
Copperbelt	70	50	60	100	600
Northwestern	60	80	120	70	200
Excess demand (tonnes)	100	400	500	300	

   a) Identify and explain the variables for this linear programming problem
   b) State algebraically the linear programming problem you would use to solve the problem. Be sure to state the role of each equation
   c) On one full page in your answer book, prepare a tableau that you would use to solve the problem using MS Excel Solver.
   d) List the steps you would use to solve this problem using the Solver in Excel
   e) Suppose the Minister asks you to prepare an advisory note on the problem based on your results. How would you advise him? [Hint: use attached computer output]
   f) What does the Copperbelt Province shadow price mean?

END OF EXAM

MS Excel Solver Output for Question 2

Microsoft Excel 11.0 Answer Report
Worksheet: [Transportation.xls]Tableau
Report Created: 17/06/2005 08:09:16

Target Cell (Min)

Cell	Name	Original Value	Final Value
$C$4	Objective function equation	0	79,000

Adjustable Cells

Cell	Name	Original Value	Final Value
$E$3	CostEast	0	100
$F$3	CostLusa	0	300
$G$3	CostSouth	0	0
$H$3	CostWest	0	300
$I$3	CopEast	0	0
$J$3	CopLusa	0	100
$K$3	CopSouth	0	500
$L$3	CopWest	0	0
$M$3	NorthEast	0	0
$N$3	NorthLusa	0	0
$O$3	NorthSouth	0	0
$P$3	NorthWest	0	0

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$C$7	Central Province equation	700	$C$7<=$D$7	Not Binding	100
$C$8	Copperbelt Province equation	600	$C$8<=$D$8	Binding	0
$C$9	Northwestern Province equation	0	$C$9<=$D$9	Not Binding	200
$C$12	Eastern Province equation	100	$C$12>=$D$12	Binding	0
$C$13	Lusaka Province equation	400	$C$13>=$D$13	Binding	0
$C$14	Southern Province equation	500	$C$14>=$D$14	Binding	0
$C$15	Western Province equation	300	$C$15>=$D$15	Binding	0
$E$3	CostEast	100	$E$3<=0	Not Binding	100
$F$3	CostLusa	300	$F$3<=0	Not Binding	300
$G$3	CostSouth	0	$G$3<=0	Binding	0
$H$3	CostWest	300	$H$3<=0	Not Binding	300
$I$3	CopEast	0	$I$3<=0	Binding	0
$J$3	CopLusa	100	$J$3<=0	Not Binding	100
$K$3	CopSouth	500	$K$3<=0	Not Binding	500
$L$3	CopWest	0	$L$3<=0	Binding	0
$M$3	NorthEast	0	$M$3<=0	Binding	0
$N$3	NorthLusa	0	$N$3<=0	Binding	0
$O$3	NorthSouth	0	$O$3<=0	Binding	0
$P$3	NorthWest	0	$P$3<=0	Binding	0

Microsoft Excel 11.0 Sensitivity Report
Worksheet: [Transportation.xls]Tableau
Report Created: 17/06/2005 08:09:16

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$E$3	CostEast	100	0	50	10	50
$F$3	CostLusa	300	0	70	10	20
$G$3	CostSouth	0	10	90	1E+30	10
$H$3	CostWest	300	0	60	10	60
$I$3	CopEast	0	40	70	1E+30	40
$J$3	CopLusa	100	0	50	20	10
$K$3	CopSouth	500	0	60	10	80
$L$3	CopWest	0	60	100	1E+30	60
$M$3	NorthEast	0	10	60	1E+30	10
$N$3	NorthLusa	0	10	80	1E+30	10
$O$3	NorthSouth	0	40	120	1E+30	40
$P$3	NorthWest	0	10	70	1E+30	10

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$C$7	Central Province equation	700	0	800	1E+30	100
$C$8	Copperbelt Province equation	600	-20	600	300	100
$C$9	Northwestern Province equation	0	0	200	1E+30	200
$C$12	Eastern Province equation	100	50	100	100	100
$C$13	Lusaka Province equation	400	70	400	100	300
$C$14	Southern Province equation	500	80	500	100	300
$C$15	Western Province equation	300	60	300	100	300

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGE 511: AGRICULTURAL ORGANIZATION AND ADMINSTRATION

TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER QUESTION 1 AND ANY FOUR (4) OF THE FOLLOWING QUESTIONS. EACH QUESTION IS WORTH 20%.

---

1. (a) What is management? Identify and briefly explain the five management functions. Cite an example of a specific activity related to performing each of the functions you have identified.

   (b) The roles played in order to fulfil management duties are diverse. Identify the various roles that managers play and briefly explain the nature of each.

2. "The Ministry of Agriculture and Cooperatives is part of the civil service bureaucracy". Comment on this statement highlighting the major characteristics of a bureaucracy. What are the problems associated with bureaucratic organizations?

3. What is communication and why is it important in the performance and management of organizations? Explain and describe the communication process. Identify and briefly outline the internal barriers to communication?

4. (a) What is leadership? What are the similarities and differences between power and authority?

   (b) Managers are expected to have a reasonably high degree of leadership ability. Identify and elaborate on the bases of power and authority.

5. Discuss the similarities and differences between Herzberg's two-factor theory and Maslow's theory of human needs. How would you apply Maslow's theory in motivating staff in a typical agribusiness organization?

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

   (c) Conflict is an everyday occurrence in organizations. As a supervisor, identify and briefly explain the five principle methods

you would employ in dealing with interpersonal conflict among subordinates.

7. Write brief notes explaining the differences between the following:

(a) Unity of Command and Span of Control
(b) Performance Appraisal and Staff Orientation
(c) Territorial Departmentation and Functional Departmentation
(d) Line Authority and Staff Authority
(e) Theory X and Theory Y

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS – JUNE 2005

AGE 531
INTERNATIONAL AGRICULTURAL MARKETS, TRADE AND DEVELOPMENT

INSTRUCTIONS:

1. Answer any five of the following questions. All questions carry equal marks and each question is worth 20%.
2. Please write **legibly**

TIME: THREE (3) HOURS

Q1. a) Give two reasons and briefly explain why every individuals' welfare in is not improved by trade. **(5 points)**

b) State at least five assumptions of the Hecksher- Ohlin Model. **(5 points)**

c) State and differentiate the **Hechsher- Ohlin** and **David Ricardo's** theories of international trade. **(5 points)**

d) Why is it that in the real world, factor prices are not equalized with trade as expected in the Hecksher-Ohlin mod-l? **(5 points)**

Q2. a) The partial equilibrium analysis is a commonly used approach in research in the area of international trade. Define what it is and what are its advantages and disadvantages. **(5 points)**

b) What are the similarities and differences between the Nominal Protection Coefficient (NPC) and the Effective Protection Coefficient (EPC)? **(5 points)**

c) State the Rybczynski Theorem. Explain using a diagram what its magnification effect is and why it is important in international trade. **(10 points)**

Q3. Among the policies influencing competitiveness and trade, state and briefly describe five (5) that are aimed at supporting the market price and five (5) that are aimed at reducing the variable costs of crop production. **(20 points)**

Q4. **Zambia** has 1200 units of labour available. It can produce two goods, apples and bananas. The unit labour requirement in apple production is 3, while in banana production it is 2. There is also another country, **Malawi**, with a labour force of 800. Foreign's unit requirement in apple production is 5, while in banana production it is 1.

a) Indicate the commodities that the two countries have absolute and comparative advantages in, and give reasons why. **(10 points)**

b) Using Production Possibility Curves and Indifference curves, explain how the two countries would gain from trading with each other (No need for any calculations). **(10 points)**

Q5. a) State and explain at least six (6) factors that hinder the effectiveness of Zambian agricultural exporters in international trade. **(10 points)**

b) Tariffs are among some of the most widely used policy instruments in international trade, state and briefly explain the **three main effects** of a tariff? **(10 points)**

Q6. A study was conducted to assess the competitiveness of the small-scale wheat sector in Zambia and came up with the following indicators.

i) A Nominal Protection Coefficient (NPC) of 0.33

ii) An Effective Protection Coefficient (EPC) of 0.21

iii) A Domestic Resource Cost Coefficient (DRC) of 0.44

What do the above indicators imply for the small-scale wheat sector and how should Zambia shape its policies in this sector if the producers have to benefit without adversely affecting its comparative advantage? **(20 points)**

Q7. For a **small** and **large** importing country, clearly differentiate the effects of imposing an import quota with the aid of diagrams. **(20 points)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 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) Project preparation and analysis has six main aspects which are interlinked. Discuss briefly four aspects of project preparation and analysis. (16 marks)

   b) "Projects are the cutting edge of development" (Gittinger). Explain what is meant by a project being the cutting edge of development. (4 marks)

2. a) Define and depict the project cycle graphically. (4 marks)

   b) Describe briefly each stage of the project cycle. (16 marks)

3. The total capital investment cost for a proposed palm oil project is K900million. The capital outlays to be incurred are as follows: first year – K250m; second year – K200m; third year – K200m; fourth year – K150m and fifth year – K100m. The projected operation and maintenance costs, the production costs and the expected gross benefits are indicated in the following table:

Amounts in K'million

Year	Cost for Capital Items	Operation and Maintenance	Production Cost	Gross Benefit
1	250	0	0	0
2	200	0	0	0
3	200	0	0	0
4	150	0	0	0
5	100	0	0	0
6	0	15	30	545
7	0	15	40	655
8	0	15	50	665
9	0	15	60	775
10	0	15	70	785

a) Compute the IRR. On the basis of the IRR you obtain and if the opportunity cost of capital were 20% would you recommend the project as good investment? Explain why? (16 marks)

b) What advantages do discounted measures of project worth have over undiscounted measures of project worth? (4 marks)

4. The foreign exchange component and the domestic currency component of a hypothetical fertilizer project are as given in the following table. (Opportunity Cost of Capital is 20%)

Year	Foreign Exchange Component (US$'000)			Domestic Currency Component (K'million)	
	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	-	80	-	150	-
2	-	110	-	200	-
3	-	110	-	200	-
4	100	-	100	100	80
5	300	-	100	-	100
6	400	-	200	-	100
7	400	-	200	-	100
8	400	-	200	-	100
9	400	-	200	-	100
10	400	-	200	-	100

a) Compute the domestic resource cost (DRC). If the official exchange rate (OER) is K5, 000 to US$1 and on the basis of the DRC you obtain, would you say that the project was favourable? Explain why? (12 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 was favourable? Explain why? (4 marks)

c) Explain why it is important to estimate the DRC and for what type of projects it should be applied? (4 marks)

5. Write short notes on the following, giving formulas where appropriate:
   a) Switching value (4 marks)
   b) Applying contingence allowances (4 marks)
   c) Traded and non-traded goods (4 marks)
   d) Project vs. Programme (4 marks)
   e) Income ratios in financial analysis (4 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

AGF 211

General Microbiology

Final Examination First Semester, 2005.

THEORY PAPER

Duration: Three Hour

SECTION A

Instructions: Answer **ALL** questions

1. a) What was the theory of spontaneous generation? Why are these theories Historically and Scientifically important? (8 marks)

   b) What contributions to the field of microbiology were made by:

   Robert Hooke

   Antoni Van Leeuwenhoek

   Louis Pasteur

   Robert Koch

   Joseph Lister

   Alexander Fleming

   And what is the significance of these contributions to modern microbiology? (12 marks)

2. Describe the life cycle of *Rhizopus Stolonifer* (Common bread mould) and the common yeast *Saccharomyces*. (20 marks)

3. a) Describe the process of glycolysis (8 marks)

   b) What is the difference between aerobic metabolism and fermentation? How do they differ in the amount of energy (ATP) produced? What is the final electron acceptor in each pathway? (12 marks)

SECTION B

Answer **ANY TWO** questions

4. Compare and contrast Cell-Mediated and Humoral Immunity (20 marks)

5. Describe the lysogenic cycle of bacteriophage Lambda (λ) and differentiate between Virus, Viroid, and Prion. (20 marks).

6. Differentiate between mechanical and chemical factors, of Non specific Defenses of the host and LIST five examples of each. (20 marks)

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

AGF 211

General Microbiology

Final Examination First Semester, 2005.

PRACTICAL PAPER

Duration: Three Hours

Instructions: Answer **ALL** questions

1. a) LIST the principal parts of the light microscope and their functions (10)

   b) i. Why is it desirable that microscope objectives be parfocal? (2)

   ii. Which objective focuses closest to the slide? (2)

   iii. What controls the amount of light reaching the ocular lens? (2)

   iv. What effects does increased magnification have on the field of vision? (2)

   v. Name two ways in which you can enhance the resolving power (2)

2. a) PERFORM Gram stain on specimen A and B, and EXPLAIN the steps of Gram staining technique. (8)

   b) Sketch a few bacteria; give magnification, morphology and arrangement, colour and Gram's reaction. (10)

   c) If you gram stain human cells, what would happen? (2)

3. a) What is the difference between chemically defined media and complex media (4)

   b) Describe THREE types of media (6)

   c) What is the value of Petri plates in microbiology and why is aseptic technique important? (4)

   d) What is the primary use of Slants? Of Deeps? Of Broth? (6)

4. a) Explain how microbes are classified on the basis of oxygen requirements (10)

   b) Explain the importance of osmotic pressure to microbial growth (6)

   d) Name a food that is preserved with Salt? With Sugar? (4)

5. a) Describe how pure cultures can be isolated by using streak plates (8)

   b) Describe the following methods used to determine the number of bacteria:

   Pour plate and spread plate (12)

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2005 ACADEMIC YEAR FIRST SEMESTER

FINAL EXAMINATIONS

221: COMPUTER SCIENCE

: THREE (3) HOURS

RUCTIONS:

WER ALL FIVE QUESTIONS.

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ion 1

e the following terms
Spam
Network
ROM
LAN
Software
Motherbody
Hyperlink
Sérifs
CPU
Internet

arks)

tion 2

Describe the 4 components of an URL.
Give the three major possibilities/functions we perform with a clip board?
Define a virus and give the types. Describe what to do with virus?
What is a reference and what types are there

larks)

tion 3

body mass index (BMI) is defined as BMI = W/H^2. In which the W is the body mass in kg and H height in meters.
a table of BMI as a function of body mass from 50 kg to 100kg in steps of 5kg and height from to 2m in steps of 0.1m. ***Save your solution in floppy disk as "BMI".***

larks)

on 4

he file "text" from my documents folder. In the text provided perform the following.

Create your own titles (headings) for selected paragraphs, up to at least three levels.
Format atleast two (2) paragraphs to two different font types, font sizes and text alignments of your choice.
Create a table of contents up to three levels.
Create an index (Two columns) with the at least 10 words of your choice.

ve your solution in floppy disk as "Word".

rks)

ion 5

chemical reactions occurring during food processing and storage follow first order-kinetics. If t the concentration of a reactant against time we get an exponential type plot (graph). The rate nt for a first-order reaction may be obtained by first taking the natural logarithm of ntration. The slope gives the first-order rate constant.

llowing data were obtained for the concentration of a reactant as a function of time.

Time (s)	Concentration (mg/L)
0	165.0
50	74.15
100	33.30
150	14.95
200	6.75
250	3.00

nine the;

i. Kinetic order
ii. Rate constant (k), and Intercept.
iii. Half life, given that

$$t_{halflife} = 0.693/k$$

your solution in floppy disk as "first order".

arks)

END OF EXAM, ALL THE BEST!!!

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS PRACTICAL

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: Answer all the questions. Marks are shown in [ ] brackets.

.....

1. A client has brought a food sample labeled **F 01** for acid content determination at your facility. Study the sample carefully and design a protocol of how you are going to analyze the sample for the required analyte. [9 marks]

2. Using your designed protocol, analyze the sample as requested by your client. You may need to standardize your reagents using suitable named primary standards. [10 marks]

3. Express the acidity of the sample as percent (w/v) acetic acid [CH_3COOH, MM = 60.053] and as tartaric acid [$C_2H_4O_2(COOH)$, MM = 150.09].[7 marks]

4. Identify the nature of the sample **F 01** if vinegar contains about 5% acid expressed as acetic acid and wine under 1% acid expressed as tartaric acid.[4 marks]

END OF PRACTICAL EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: Answer any **four** questions. Questions carry equal marks.

---

1. (a) (i) Describe the steps involved in a sampling operation of a foodsample. [3 marks]

(ii) Briefly discuss food sampling at a named food production factory. What possible problems would you get and how would you overcome them? [5 marks]

(b) (i) Why would you prefer dry ashing a food sample to wet ashing? [2marks]

(ii) How would you prepare a protein free filtrate (PFF) of a named food sample? [3marks]

(c) A food sample was found to contain 0.203mg of zinc. If the sample was 0.156g, what is the concentration in parts per million and parts per billion? [4marks]

(d) To recover levels of tin from foodstuffs, samples are boiled for different times in an open vessel as follows:

30 minute boiling: 57,57,55,56,56,55,56,55
75 minute boiling: 51,60,48,32,46,58,56,51

Test whether the boiling time affects the variability of the results and the mean of the recovery of tin at 95% confidence limit. [8marks]

2. (a) Explain what is meant by a:

(i) random error
(ii) systematic error

Give a practical example of each and discuss how they may be reduced or eliminated. [8marks]

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS

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2. (a) Explain what is meant by a:

(i) random error
(ii) systematic error

Give a practical example of each and discuss how they may be reduced or eliminated. [8marks]

(b) Paracetamol syrup contains 0.01% p-hydroxymethylbenzoate (MB) as preservative. Five millilitres (mL) of the syrup is diluted to 32mL and chromatographed and given an area of 27.1×10^{-3}. Linear regression of pure MB standard solutions gives the following values when peak area is plotted versus concentration (μg/mL).

Correlation coefficient:	0.9998
Slope:	6.20×10^{-3}
Y-axis intercept:	2.64×10^{-4}

Calculate the quality percent of the MB. [7marks]

(c) (i) State the importance of separation methods in food analysis. [1mark]

(ii) Describe the types of extractions used in the analytical food laboratory. [6marks]

(d) If you wish to extract aqueous acetic acid into hexane, is it more effective to adjust the aqueous phase to pH 3 or pH 8? [3marks]

3. (a) (i) What is the basic principle underlying all chromatographic processes in a food laboratory? [3marks]

(ii) Define the following terms used in chromatography by giving an equation, labelled diagram or description: resolution, retention time, stationary phase, theoretical plates. [11marks]

(b) A gas chromatographic peak had a retention time of 65seconds. The base width obtained from the intersection of the baseline with the extrapolated sides of the peak was 5.5seconds. If the column was 3m in length, what was the plate height (H) in cm/plate? Comment on the efficiency of this column. [7marks]

(c) A series of methyl esters of the fatty acids were chromatographed. Time (in minutes) at peak maximum for known saturated esters were: $C_{12} = 2.65$; $C_{14} = 4.6$ and $C_{20} = 27.0$. On a sample run under identical conditions, peaks were observed at 2.55; 8.3; 15.2; 26.9 and 48 minutes. What esters were present in the sample? [5marks]

4. (a) The determination of sulphur dioxide (SO_2) in fruit drink was performed as follows: nitrogen gas was bubbled at a rate of 20L/minute through a trap containing hydrogen peroxide (H_2O_2). The sulphuric acid produced in 30 minutes ($SO_2 + H_2O_2 \longrightarrow 2H^+ + SO_4^{2-}$) was titrated with 5.6cm^3 of 0.01M NaOH solution. Calculate the concentration of the SO_2 in the sample in ppm given the density of SO_2 is 2.86mg/cm^3. Use S = 32. [7marks]

(b) Describe how to carry out a non-aqueous titration, highlighting the differences in dealing with basic and acidic compounds. Why is it necessary to use this technique? [5marks]

(c) Discuss in detail the importance of molecular filtration in food science and how the process differs from dialysis. [7marks]

(d) Explain the difference between a direct titration, a back titration and substitution titration. [[6marks]

5. (a) (i) What is the difference between a separation by precipitation and a gravimetric method of analysis of a food sample? [2marks]

(ii) What determines the effectiveness of precipitation as a chemical method in food analysis? [2marks]

(b) A 1.000g sample of food is analyzed for nitrogen by the Kjeldahl method. After digestion of the sample, the ammonia is distilled and collected in a receiver containing exactly 50cm^3 of 0.1000M HCl. The unreacted HCl requires 24.60cm^3 of 0.1200M NaOH for back titration. Calculate the percentage of nitrogen (N) in the sample. [9marks]

(c) (i) What is the most important characteristic of the reference standard solution used in volumetric analysis of a food sample? [3marks]

(ii) Describe the steps required in a volumetric analysis in a food sample.

Outline the possible errors in this technique.

How would you reduce or eliminate these errors? [9 marks]

END OF EXAMINATION

ANNEX

VALUES OF t FOR V DEGREES OF FREEDOMS FOR VARIOUS CONFIDENCE LEVELS.

v	CONFIDENCE LEVEL			
	90%	95%	99%	99.5%
1	6.314	12.706	63.657	127.32
2	2.920	4.303	9.925	14.089
3	2.353	3.182	5.841	7.453
4	2.132	2.776	4.604	5.598
5	2.015	2.571	4.032	4.773
6	1.943	2.447	3.707	4.317
7	1.895	2.365	3.500	4.029
8	1.860	2.306	3.355	3.832
9	1.833	2.262	3.250	3.690
10	1.812	2.228	3.169	3.581
15	1.753	2.131	2.947	3.252
20	1.725	2.086	2.845	3.153
25	1.708	2.060	2.787	3.078
∞	1.645	1.960	2.576	2.807

v = N-1 = Degrees of freedom.

REJECTION QUOTIENT, Q, AT DIFFERENT CONFIDENCE LIMITS

Number of observation	Confidence Level		
	Q90	Q95	Q99
3	0.94	0.970	0.994
4	0.76	0.829	0.926
5	0.64	0.710	0.821
6	0.56	0.625	0.740
7	0.51	0.568	0.680
8	0.47	0.526	0.634
9	0.44	0.493	0.598
10	0.41	0.466	0.568
15	0.338	0.384	0.475
20	0.300	0.342	0.425
25	0.277	0.317	0.393
30	0.260	0.298	0.372

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
																1 H 1.01 Hydrogen	2 He 4.00 Helium
1 H 1.01 Hydrogen												5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
3 Li 6.94 Lithium	4 Be 9.01 Beryllium											13 Al 27.99 Aluminium	14 Si 28.09 Silicon	15 P 30.99 Phosphorus	16 S 32.07 Sulphur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
11 Na 23.00 Sodium	12 Mg 24.31 magnesium											31 Ga 69.72 Gallium	32 Ge 71.61 Germanium	33 As 74.92 Arsenic	34 Se 78.96 selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.88 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.65 Copper	30 Zn 65.39 Zinc	49 In 114.82 Indium	50 Sn 118.71 Tin	51 Sb 121.76 Antimony	52 Te 127.60 tellurium	53 I 126.90 Iodine	54 Xe 131.2 Xenon
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc 97.91 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.91 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.87 Silver	48 Cd 112.41 Cadmium	81 Tl 204.38 Thallium	82 Pb 207.2 Lead	83 Bi 208.98 Bismuth	84 Po 208.98 Polonium	85 At 209.99 Astatine	86 Rn 222.0 Radon
55 Cs 132.91 Caesium	56 Ba 137.33 Barium	57 – 71	72 Hf 178.49 Hafnium	73 Ta 180.95 Tantalum	74 W 183.84 Tungsten	75 Re 186.21 Rhenium	76 Os 190.23 Osmium	77 Ir 192.22 Iridium	78 Pt 195.08 Platinum	79 Au 196.97 Gold	80 Hg 200.59 Mercury						
87 Fr (223.02) Francium	88 Ra 226.03 Radium	89 - 103	104 Unq 261.11	105 Unp 262.11	106 unh 263.12	107 uns 262.12	108 Uno 265.00	109 Une 265									

57 La 138.91 Lanthanum	58 Ce 140.12 Cerium	59 Pr 140.91 Praseodymium	60 Nd 144.24 Neodymium	61 Pm 144.91 Promethium	62 Sm 150.36 Samarium	63 Eu 151.97 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.93 Terbium	66 Dy 162.50 Dysprosium	67 Ho 164.93 Holmium	68 Er 167.26 Erbium	69 Tm 168.93 Thulium	70 Yb 173.04 Ytterbium	71 Lu 174.97 Lutetium
89 Ac 227.03 Actinium	90 Th 232.04 Thorium	91 Pa 231.04 Protactinium	92 U 238.03 Uranium	93 Np 237.05 Neptunium	94 Pu 244.0 Plutonium	95 Am 243.06 Americium	96 Cm 247.07 Curium	97 Bk 247.07 Berkelium	98 Cf 251.08 Californium	99 Es 252.83 Einsteinium	100 Fm 257.10 Fermium	101 Md 260 Mendelevium	102 No 259.10 Nobelium	103 Lr 262.11 Lawrencium

KEY

Atomic number
X
Atomic mass

Name of the element X

Values of F at 95% confidence level

v_1 = 2	3	4	5	6	7	8	9	10	15	20	30
v_2 = 2	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.5
3	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.70	8.66	8.62
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.86	5.80	5.75
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.62	4.56	4.50
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	3.94	3.87	3.81
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.51	3.44	3.38
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.22	3.15	3.08
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.01	2.94	2.86
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.85	2.77	2.70
15	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.40	2.33	2.25
20	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.20	2.12	2.04
30	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.01	1.93	1.84

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
FOOD SCIENCE AND TECHNOLOGY DEPARTMENT
FIRST SEMESTER FINAL EXAMINATION

AGF 321 FOOD CHEMISTRY

INSTRUCTIONS
ANSWER ANY FIVE QUESTIONS OF YOUR CHOICE. All QUESTIONS CARRY TWENTY (20) POINTS.
DURATION THREE HOURS

---

1. (a) What are Vitamins? What are the general causes of losses of vitamins. Ascorbic Acid is highly sensitive to various modes of degradation. **(10 points)**

   (b) What are these modes and what factors influence the degradation mechanisms? Describe the degradation mechanisms followed when some of he factors you have mentioned are present. **(10 points)**

2. (a) Addition of nutrients to processed foods are was of impreving nutrient content. Name five ways o doing it commercially and explain under what circumstance each method is used. **(10 points)**

   (b) Name and describe three non-enzymatic browning reactions. Describe their industrial significance. How can they be prevent. **(10 points)**

3. (a) What is the major difference between minerals and Vitamins. Why are minerals important in human diets? Give three examples of mineral related deficiencies. What are the chemical and functional properties. **(10 points)**

   (b) Define lipids What important role do they play in food industry and human diet?. How are lipids and fats classified chemically. **(10 points)**

4. How are fats and oils obtain industrially? Describe in detail the refining process of oil. Explain why each processing step is important. Name one company in Zambia which refines its oil before selling it to the public. **(20 points)**

5. (a) Describe the role of Singlet oxygen O_2 in auto oxidation processes? How is it generated? How can it be stopped. **(10 points)**

   (b) In degradation reactions of lipids, describe lypolysis in details with illustrations. How does this affect food quality? What factors propel it. How can you tell that the Quality of a food has been affected by lypolysis. **(10 points)**

6. (a) Explain the following:

- Latent enzymes
- Reversion
- Phosphatase Test
- Hay like aroma and what causes it
- $\propto$ amylase and β amylase **(10 points)**

(b) What is polymerization. How can you tell using laboratory methods that this process has occurred? What are the reaction products? What is the major concern about these reaction products? Which processing method has the greatest potential in producing polymerization products. What compounds are produced during this process? Are all change during polymerization harmful? Explain your answer.

(10 points)

7. A variety of vegetable where transported from Mwinilunga to Lusaka in an open van to a factory to be further processed. Some of the vegetable were blanched, some were not blanched. Explain the type of losses that are encountered during transportation, blanching and trimming. What about those vegetables that were not subjected to any processing activities. Explain in detail what is happening in terms of vegetable quality. Explain the chemistry of quality in the trimmed vegetables. **(20 points)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
FOOD SCIENCE AND TECHNOLOGY DEPARTMENT
FIRST SEMESTER FINAL EXAMINATION
COURSE: FOOD CHEMISTRY AGF 321 PRACTICAL

INSTRUCTIONS
QUESTION ONE IS COMPULSORY
ANSWER ANY OTHER FOUR QUESTIONS OF YOUR CHOICE ALL QUESTIONS CARRY 20 POINTS

1. **SECTION I**
   - **(a)** The Keldahl method of crude protein determination is one method of determining crude protein. Is this the only method used for protein determination if not mention at least three methods you know.
   - **(b)** Name the three reagents added during sample digestion, Why are they added. **(3 Points)**
   - **(c)** If upon digesting for a long time no colour changed to the sample you were digesting what possible things could have gone wrong **(4 Points)**
   - **(d)** Why can distillation not proceed without the distillation step.**(3 Points)**
   - **(e)** What reagent is added at the distillation stage and what is its function **(2 Points)**
   - **(f)** Explain what would happen if standardization is omitted at the titration stage. **(3 Points)**

SECTION 11

2. If you were in charge of product development in a food company and you were given a new food product, explain step by step how you would determine its moisture, fat and ash. How can this information be useful in as far as this product is concerned
3. You are given two different samples of food products whose moisture content is 15%. One product is very stable at this moisture content while the other is highly unstable. Explain how you will convince the person who has given you the sample that this is an expected phenomenon. What explanation tool would you use to make your answer convincing, **(20 Points)**
4. You have been given a sample with obvious signs of rancidity. Explain how you would carry out an analysis that will demonstrate that this product has indeed gone rancid. What would be your scientific explanation for this condition? What would be your advice on how to stop such type of quality in this type of foodstuff

5. Explain the properties of colloids in term of the following
   (a) Rate of settling
   (b) Filterability
   (c) Colligative properties
   (d) Brownian Movement

6. Define the following
   (a) Refractive index and its significance in food technology
   (b) Non protein Nitrogen what is its significance in protein determination
   (c) Saponification Value, when is it determined
   (d) Isoelectric point of proteins what is crucial about this point

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THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 341 – Technical Thermodynamics

Instructions: Answer **Five (5)** questions; answer **question 1** and **any other 4**. Answer **question 1in a separate booklet**.

Time allowed: Three (3) Hours

Q.1

a. What factors are taken into consideration when conditioning air for a cold room in which meat is to be stored?
b. Define
   i. Wet bulb temperature
   ii. Relative humidity
c. Mention 4 drying techniques you know. **[20]**

Q.2

a. Discuss the principle of vacuum cooling and freezing, giving examples of the products cooled by these techniques. **[8]**

b. A 2kg-box made of polypropylene (cp=1.9kJ/kg_K) contains 38 kg of bukabuka fish with a water content of 83% (by mass) at 10°C. The fish is to be frozen to an average temperature of -20°C in 4h in its box. The specific heat of the fish is 3.62 kJ/kg.K above the freezing temperature of -2.2°C, and 1.89kJ/kg.K below the freezing temperature. Determine the total amount of heat that must be removed from the fish and the average rate of heat removal from the fish. **[12]**

Q.3

a. What is the difference between P-v and T-v diagram? Show and label the critical point as well as the phase changes in each diagram. **[9]**

b. Steam enters an adiabatic turbine at 8Mpa and 550°C with a mass flow rate of 3kg/s and leaves at 30kPa. The isentropic efficiency of the turbine is 90%. Determine:
   i. the temperature at the turbine exit **[4]**
   ii. the power output of the turbine **[7]**

Q.4

Air is compressed from an initial condition of 1 bar and 25°C to a final state of 5 bar and 25°C by three different mechanically reversible processes:

a. Heating at constant volume followed by cooling at constant pressure.**[7]**
b. Isothermal compression. **[6]**
c. Adiabatic compression followed by cooling at constant volume. **[7]**

At these conditions, air may be considered an ideal gas with the constant heat capacities, Cv = (5/2)R and Cp = (7/2)R.

Calculate the work required heat transferred, and the changes in internal energy and enthalpy of the air for each process.

Use R= 8.314 J $mol^{-1}K^{-1}$ and assume air is an ideal gas which has a volume of 0.02271m^3/mol at 0°C at 1bar.

Q.5

a. Explain how the actual-vapour compression refrigeration cycle differs from the ideal-vapour compression refrigeration cycle with the aid of diagrams. [**10**]
b. Which type of refrigerant is used in industry and why? [**5**]
c. Describe the cascade refrigeration system. [**5**]

Q.6

a. Explain and illustrate the Carnot cycle. [**7**]
b. What is the difference between a heat pump and a refrigerator? [**6**]

c. A heat pump is used to heat a house and maintain it at 22°C. On a cold day when the outdoor air temperature is 2°C, the house is estimated to lose heat at a rate of 65,000kJ/h. Determine the minimum power required to operate this heat pump. [**7**]

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THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2005 ACADEMIC YEAR FIRST SEMESTER

FINAL EXAMINATIONS

AGF 411: FOOD ENGINEERING

TIME: THREE (3) HOURS

INSTRUCTIONS:

ANSWER ALL FIVE QUESTIONS.

OPEN BOOK EXAM, HANDOUTS AND TABLES ALLOWED

SOLVED NUMERICAL EXAMPLES AND EXERCISES NOT ALLOWED

Question 1

Is $y = x^2 - 3$ a linear equation? If not, can you linearize it in another form? Determine the slope and the intercept of the linear equation.
What are the advantages of linearization of data? Discuss your answer and give and example. **(15pts)**

Question 2

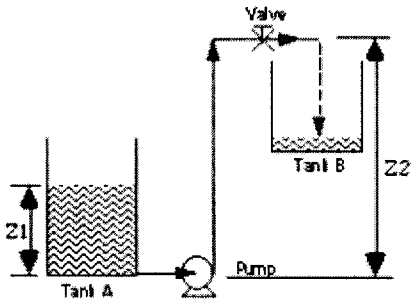
Explain how the Reynolds number determines the flow condition in a pipe.

a. What happens when μ doubles?
b. What happens when v is four times?

Discuss your answer. **(15pts)**

Question 3

Water at standard conditions (ρ = 1000 kg/m3; μ= 1535 x 10-6 Pa s) is being pumped at a mean velocity of 0.15 m/s from constant-level tank A to the top of tank B as shown. The pipe diameter is 0.02 m, there are 100 m of straight pipe, two 90š elbows (standard), the inlet from tank A, and one fully-open gate valve. Height Z1 = 1 m; height Z2 = 11 m. (Note: You may not need all of this information to answer these questions.)



Required:

a. Calculate Reynolds' number for this system.

b. Is the flow laminar or turbulent?

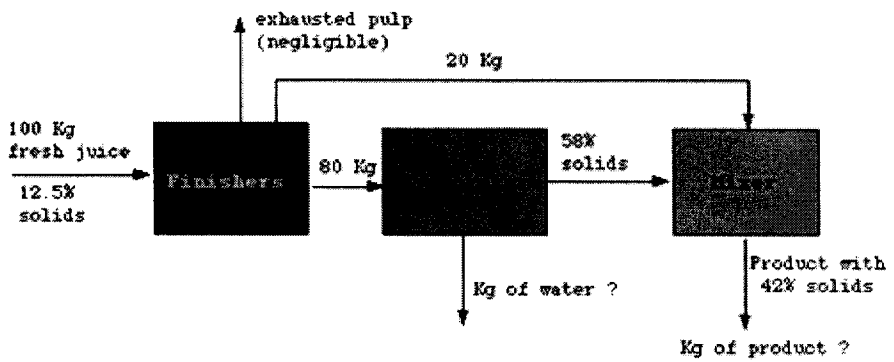
c. What is the value of α for Bernoulli's equation?

d. For a Reynolds' number of 2,000 and a friction energy E_f of 0.0365 J/kg, calculate the pumping energy required using Bernoulli's equation.

(20pts)

Question 4

Orange juice is prepared as follows (see figure):
The fresh juice (100 kg, 12.5% solids) is forwarded to a finisher where exhausted pulp is removed. This stream may be assumed to be negligible.
The resulting juice is split in two streams with different content in solids. The first stream 80% of the finisher feeding is send to the evaporator where it is concentrated up to 58% solids. The second stream (20%) is used to dilute the concentrated juice (58% solids) to obtain a final product having a concentration of 42% solids.
Calculate the amount of water to be evaporated, the amount of the final product and the solid concentration in each stream leaving the finisher. **(25pts)**



Question 5

Milk (cp = 3.9 kJ/kgK) is cooled in a countercurrent flow heat exchanger at a rate of 1.5 kg/s from 70°C to 30°C. Cooling is done by using chilled water available at 5°C with a flow rate of 2 kg/s. The inside diameter of the inner pipe is 2 cm. The overall heat transfer coefficient is 500 W/m2°C. Determine the length of the heat exchanger. **(25pts)**

THE UNIVERSITY OF ZAMBIA

First Semester Examination 2005

AGF 421 THEORY
FOOD TECHNOLOGY I

Answer question 8 and any other 5 questions, each question carries 10 marks

1. Compare sterilization and UHT for the heat treatment of low viscous and liquid foods.
2. Which factors influence the T of an evaporation process? Discuss.
3. Spray drying can occur in a counter current or a co-current mode. Compare and discuss both configurations, giving pros and cons of each.
4. How does a multiple effect evaporator operate? Discuss the advantages of forward feeding over backward feeding.
5. What are the applications of radiation in the food industry? Discuss in detail.
6. Which factors influence the freezing rate. Discuss in detail.
7. Discuss and illustrate the following: Heat recuperation is a major issue in food technology.
8. Discuss in five lines
   - fricke
   - mollier diagram
   - solar drying
   - IQF
   - freezer burn

GOOD LUCK !

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

First Semester Examination 2005

AGF 421 PRACTICAL, OPEN BOOK

FOOD TECHNOLOGY I

Answer all questions

1. A liquid food product with specific heat capacity of 3.5kJ/kgK is heated in a counter current heat exchanger from 20°C to 80°C. Steam with a temperature of 125°C is used as heat medium at a flow rate of 3kg/s. Calculate the product flow rate when the efficiency of the heat exchanger is 80%. **(10 marks)**
2. Calculate the rate of heat energy emitted by 100 m^2 of a polished iron surface (emissivity = 0.06). The temperature is 37°C. **(7.5 marks)**
3. One face of an iron plate 2 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. **(7.5 marks)**
4. A forward feed evaporator is used to concentrate milk from 10% total solids to 70%. The milk enters at 250kg/h at 25°C. The liquid in the second effect boils at 70°C (under vacuum). The first effect is heated by steam at 198.5kPa. The product of the first effect leaves at 90°C. The specific heat capacity of the liquid as is goes through the evaporation process is 3.8, 3.0 and 2.5 kJ/kg°C at entry, 1st effect and final effect respectively.
   - Calculate the flow rate of steam.
   - If the overall heat transfer coefficient is 750w/m^2°C in the first effect, calculate the area of the effect.
   - What is the steam economy
   - If *C. Botulinum* contaminated the product, how much heat treatment would this process subject it to?

   (15 marks)

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

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

ST SEMESTER FINAL EXAMINATION

URSE: AGF 441 WATER AND FOOD WASTE TREATMENTS
TE: 27TH JUNE 2005
IE: 14:00 HOURS TO 17:00 HOURS

TRUCTIONS: -
SWER ANY FIVE QUESTIONS OF YOUR CHOICE
L QUESTIONS CARRY 20 POINTS
RATION THREE HOURS

Describe with a diagram the activated sludge treatment process. What is the status of microorganisms foun in this type of sludge? Describe how the same type of microorganisms chosen for a specific function i maintained. What are the major products of activated sludges which is not a major product? Name fiv types of specialized sludges. **(20 Points)**

What is composting? Describe the conversion process with a diagram. Which materials are suitable fo composting and which ones are not? Name the 5 factors, which impacts the quality of the compost, explai how each one of them, impact the quality. Why is this process important in environment management. **(2 Points)**

Describe the water treatment process at the Kafue water works in detail from the intake transmission an until it reaches consumers, In your explanation mention which processing stages are physical, chemical o biological. Explain with a flow diagram **(20 Points)**

What role do the following play in reducing BOD in wastewater? Explain how they function. Describe th Microorganisms found in each. What are the major disadvantages of these systems?

Trickling filters **(5 Points)**
Anaerobic Ponds (**5 Points**)
Facultative ponds **(5 Points**
Maturation ponds (**5 Points**

(a) What is water hardness? Explain how water hardness types can be removed. What is Breakeve point in water chlorination. What should be taken care of before this stage is reached? Explain the differen terms used to define different chlorine demands of water with different levels of impurities, why is i important to know these chlorine demands (**10 Points)**

(b) Describe nitrifying and denitrifying processes in water and wastewater treatment. Why are thes processes important what types of waste do they deal with? **(10 Points)**

Why is Plant Sanitation important? Describe the following:- Sanitation Schedule, Production Periods, Preparation, Gross Removal, Pre-rinse, Cleaning, Inter-rinse, Disinfection Post rinse and Performance Assessments in relation to Sanitation in a factory **(20 Points)**

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 511 – Unit Operations of Food Engineering II

Instructions: Answer **Five (5)** questions; At **least two (2)** from each section and the fifth from either section. Answer **sections 1 and 2 in separate booklets**.

Time allowed: Three (3) Hours

SECTION 1

1. A maximum of 45mol% A and 55mol% B has to be distilled in order to obtain a distillate of 90mol% A and a residue of 10mol% of A.

   The feed is introduced at a temperature of 10°C and it has a boiling point of 93°C.

   The molecular weights of A and B are 78 and 92, respectively. The specific heat capacities of A and B are 140 and 167 $KJ.Kmol^{-1}C^{-1}$, respectively. The heat vapourisation of the feed is 31 000KJ / Kmol; the relative volatility of A/B is 2.5 and the reflux ratio is 2.

   Calculate:

   a. The minimum reflux ratio (**5 Marks**)
   b. Amount of distillate and residue (**10 marks**)
   c. The total number of stages (including the reboiler) - (**5 marks**)

2. A starch solution with 25% water is to be extracted and dehydrated to 3% water. The extraction is to be done by use of ethanol that contains 5% water by way of a counter current extractor. After centrifugation, the raffinate has 60% starch and 40% solution. For every 10 000kg feed, 8000kg of solvent is used.

Calculate:

a. Amount of final extract and final raffinate (**8 marks**)
b. Composition of final extract and final raffinate (**8 marks**)
c. Number of stages required in the extractor (**8 marks**)

3.

a. Discuss the process of adsorption (**10 marks**)
b. Describe two (2) major adsorption processes in which adsorption is used in the oil extraction and refinery industry (**10 marks**)

4. Milk is to undergo UHT (ultra high temperature) processing with a concurrent tubular heat exchanger being used as a method of heating. UHT low fat (2%) fluid milk is to be produced at 5000kg/hour with a desired time / temperature of 2seconds at 150°C. Milk with an initial temperature of 15°C is fed to the heat exchanger and steam at 543.1KPa and of 100% quality is used as the heating media. Condensate at 155°C flows from the steam trap.

   The composition of the 2% low fat milk is given as 89.2% Moisture, 3.3% Protein, 2% Fat, 4.8% carbohydrates and the rest is ash.

a. Construct and label a simple process flow chart showing the concurrent flow of the milk and steam (**5 marks**)
b. Determine the specific heat capacity (Cp) of the low fat milk using the data given (**5 marks**)
c. Write appropriate energy balance equations (i.e. incoming milk, outgoing milk, incoming stream of steam and also the outgoing stream of the condensate). Reference state: water at 0°C.

   With this information, solve for the amount of steam required to achieve processed UHT low fat milk at the given conditions (**10 marks**)

   Note that enthalpies of incoming components = enthalpies of leaving components.

5.

a. Name and describe three types of trays used in gas absorption plate columns (**6 marks**).

b.

i. Name and briefly describe the three types of tray efficiencies common to both distillation and absorption tray efficiencies (**6 marks**).

ii. Calculate the number of ideal trays of a Hydrocarbon absorption tray with an efficiency of 40% and consisting of eight trays including a reboiler (**4 marks**).

c. Give the name of the chief reason for poor performance in large packed towers and a remedy for this problem (**4 marks**).

SECTION 2: Answer at least 2 questions in a separate booklet.

1. A feed of 4,535 kg per hour of a 2.0wt% salt solution at 311K enters continuously a single-effect evaporator and is being concentrated to 3.0%. The evaporation is at atmospheric pressure and the area of the evaporator is 65.7m^2. Saturated steam at 383.2K is supplied for heating. Since the solution is dilute, it can be assumed to have the same boiling point as water. The heat capacity of the feed can be taken as c_p = 4.10 kJ/kg.K.

a. Calculate the amount of vapour and liquid product and the overall heat transfer coefficient U. (**8 marks**)

b. Calculate the amounts of liquid and vapour leaving and the liquid outlet concentration if the feed rate is increased to 6,704kg per hour using the same area and value of U obtained in a. (**12 marks**)

2. a) Discuss the differences between the forward-feed, backward-feed and parallel-feed multiple-effect evaporators. Give an example of the types of products produced from these evaporators. (**12marks**)

b) What is the difference between a circulating-liquid evaporator-crystallizer and a circulating-magma vacuum crystallizer? (**8 marks**)

3. a) Explain the importance of supersaturation in crystallization and how it is achieved. How does it influence the design of crystallizers? (**7 marks**)

b) A batch of 1000kg of KCl is dissolved in sufficient water to make a saturated solution at 363 K, where the solubility is 35 wt% KCl in water. The solution is cooled to 293 K, at which temperature its solubility is 25.4 wt%.

i. What is the weight of water required for solution and the weight of crystals of KCl obtained? (**7 marks**)
ii. What is the weight of crystals obtained if 5% of the original water evaporates on cooling? (**6 marks**)

Data for the Examination

$F = D + B$

$x_D / R_D + 1$

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

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

$q = 1-f$

$- q / 1-q$

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

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

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

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

$C_p = 1.675 + 0.025\ w$

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

$\Delta H_s = m_s H_s$ or $\Delta H_s = m_c H_c$

From steam tables

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

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

$\Lambda = Hs - hs$

$F = L + V$

$Fx_F = Lx_L$

$q = U A \Delta T$

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

$q = (H_2 + Hv) - H_1$

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY
2005 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGF 531: TECHNOLOGY OF PLANT PRODUCTS I

TIME: THREE (3) HOURS

INSTRUCTIONS:

ANSWER ALL FIVE QUESTIONS.

ANSWER EACH QUESTION IN A SEPARATE ANSWER BOOKLET.

Question 1

In their efforts to control costs, Tiger animal feeds wish to start producing their own raw materials for animal feeds. Some of the important raw materials are "Corn gluten meal" and "Corn germ meal". Describe in detail how they can obtain these products from maize. (Show the process flow diagram).

(20 Points).

Question 2

What is parboiling of rice and what are the advantages of processing rice in this format.

(20 Points).

Question 3

As a consultant, you have been approached by Amanita premium oils on the production of margarine. Describe to them how they can produce this product starting from the raw material soy beans to the end product margarine.

(30 Points).

Question 4

Bread forms an important part of diet in Zambia.

List the ingredients utilized in industrial bread making and their functions.

(10 Points).

Question 5

Explain the following terms (maximum of 5 lines each);

I. Dry Rendering
II. Gluten
III. Rope (in bread)
IV. Tampering (in Wheat milling)
V. Enolate mechanism
VI. Hydrobleaching
VII. Textured Vegetable Protein (TVP)
VIII. Mayonnaise
IX. Beany Flavour (in soy milk)
X. Semolina

(20 Points).

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2005 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 541 – Technology of Dairy and Egg Products

Instructions: Answer **Five (5)** questions; answer **all from section one** and **least two (2)** from section 2. Answer the **two sections in separate booklets**.

Time allowed: Three (3) Hours

SECTION 1: Dairy Technology

1. Describe the butter manufacturing process and explain the importance of the different steps involved in this process. (**15 points**)

2. You are invited for interviews at Diamondale and a member of the panel would like to know which starter culture you would use for yoghurt making and why? How would you increase its yield? Further, the panel would like to know whether homogenization is beneficial or not in cheese manufacturing. (**12 points**)

3. Explain the steps in the processing of pasteurised milk at Pamalat from reception to packaging. What tests are done on pasteurized milk that is packed after a day in storage? Why is UHT milk incubated after packaging at Pamalat and how long is it kept? (**13 points**)

SECTION 2: Technology of Eggs – Answer any **two** questions in a **separate booklet.**

1. Draw the egg and show its parts. From your diagram, show the part of the egg, which is good as an emulsifier, why? Describe the other vital functional and nutritional properties of eggs. Define what an emulsifier is. (**10 points**)

2. From production to the time they are consumed, describe all the various quality measures that are taken to ensure that the eggs are fit for human consumption. As you explain, describe why each quality measure is taken. **(10 points)**

3. Egg processing and preservation is important in industry, why? Describe methods of egg preservation and the products produced. Explain in detail where these preservation products are used in industry. What processing methods should be avoided if the quality of eggs for future is to be preserved? (**10 points**)

UNIVERSITY OF ZAMBIA
END OF FIRST SEMESTER EXAMINATION
AGS 211
FUNDAMENTALS OF SOIL SCIENCE I

June 23, 2005

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

1. Define the following terms: (**10 marks**)
   a) Sesquioxide
   b) Nitrification
   c) Texture
   d) Bulk density
   e) Streak
   f) Isomorphous substitution
   g) Hydrolysis
   h) Mycorrhizae
   i) Sand
   j) Photoautotrophic microorganism

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

   a) Biotite is a primary mineral whose chemical formula is $Al_2\ Si_2O_5(OH)_4$.

   b) A soil with a bulk density of $1.4g.cm^{-3}$ will have a lower total porosity than one with a bulk density of $1.59g.cm^{-3}$ if both soils have the same particle density.
   c) Facultative bacteria require oxygen for their survival but can survive in environments where oxygen is not present.
   d) Potassium fixation occurs in soils where vermiculite is the dominant clay mineral.
   e) Phosphate fixation is associated with soils containing high amounts of quartz.
   f) Protozoa are unicellar heterotrophic eukaryotic microorganisms.
   g) All minerals that are able to scratch Apatite must have a hardness of 7 or more on Mohr's scale.
   h) A hydrometer is an instrument used to measure gravimetric moisture content of soils.
   i) A sandy loam soil contains more sand than a loamy sand
   j) The friction force in Stokes' equation is represented by the equation $F = 2\pi rT\cos\theta$.

3 Answer the following questions briefly and concisely (**20 marks**)

a) Discuss the properties of kaolinite and Smectite in terms of their cation exchange capacity (or charge), specific surface area and ability to swell and contract and relate these to the structure of the minerals. (5 marks).

b) What are the ecological adaptations (requirements) of Fungi and Actinomycetes in soil? Discuss the important roles that these two groups of organisms play in soils. (5 marks)

c) Briefly describe the properties of humus and its effect on the physical and chemical properties of soils. (5 marks)

d) Give the names of the minerals whose chemical formula are given below and indicate whether they are primary or secondary minerals.
$CaSO_4.2H_2O$, $Al_2Si_2O_5(OH)_4$, SiO_2, Fe_2O_3 and $KAl_2(AlSi_3)O_{10}(OH)_2$.
(5 marks)

4. A 60 gram sample of soil with a gravimetric moisture content of 6 % contains 15 grams of gravel. After sieving the soil through a 2mm sieve, the fine earth fraction is dispersed to make a 2.0 liter suspension. Answer the following questions **(20 marks)**.

a) What is the oven dry mass of the fine earth fraction of this soil? (5 marks)

b) If the corrected hydrometer readings of the suspension 40 seconds and 8 hours after agitation are 8.8g/L and 5.6 g/L respectively; calculate the percentages of sand silt and clay in the fine earth fraction of the soil. (12.5 marks).

c) Indicate the position of the texture of this soil on the textural triangle below. (2.5 marks)

5. A moist soil collected from a field near a dambo has a total porosity of 40 % and a gravimetric moisture content of 10 %. If the ~~bulk density of the~~ particle density of the soil is 2.65 g. cm^{-3}. Answer the following questions: **(20 marks)**

a) What is the bulk density of the soil? (4 marks)

b) What is the volumetric moisture content of the soil? (4 marks)

c) What is the equivalent depth of water present in the soil? (4 marks)

d) What is the air filled porosity of this soil? (4 marks)

e) If there is a water table 1.5 metres below the soil surface, how deep from the soil surface should you dig to reach the region where soil pores with a diameter of 0.05mm are filled with water? Given the formula $h = 0.15/r$, where h = height or rise of water in cm above free water surface, and r is radius of pores filled with water in cm. (4 marks)

6. A soil sample collected from the top 25 cm of a farmer's field has a bulk density of 1.3g $.cm^{-3}$. If 100 grams of this soil contains 1.5 % organic carbon, and the following amounts of exchangeable cations: 3 mg potassium (K^{+}) , 4 mg Calcium (Ca^{2+}), 2 mg magnesium (Mg^{2+}) 3mg sodium (Na^{+}) 5 mg of aluminum (Al^{2+}), and 3 mg hydrogen (H +), answer the following questions about this soil. **(20 marks)**

   a) What is the Cation Exchange Capacity of this soil? (4 marks)

   b) If the farmer wants to grow a crop that requires 120 kg of K per hectare, will the amount of exchangeable K in the soil meet this requirement? Support your answer with calculations (4 marks)

   c) How much organic matter is initially present in a 1 Lima (0.25Ha) plot of this soil (4 marks)

   d) If the soil loses 20mg org C/100grams soil per month due to microbial respiration, how much organic matter is lost per hectare in 6 months as a result of microbial respiration? (4 marks).

   e) How much organic matter should the farmer apply every year to maintain the same level of organic matter in the soil, assuming the only loss of organic carbon from the soil is due to microbial respiration and that the respiration rate is constant. (4 marks)

NOTE: *Submit page with textural triangle together with answer sheet*

END OF EXAMINATION

TEXTURAL TRIANGLE TO BE SUBMITTED WITH ANSWER SHEET

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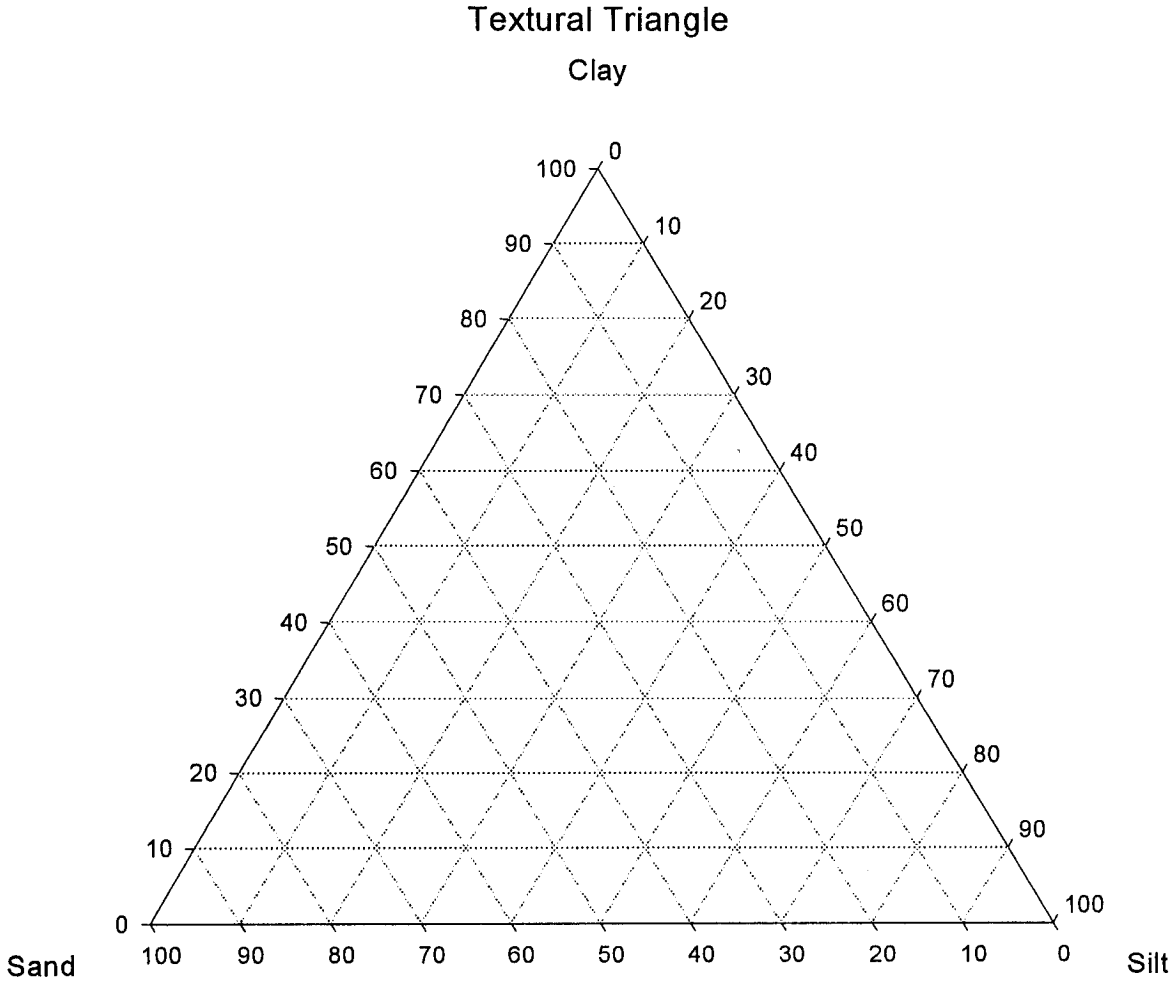

UNIVERSITY OF ZAMBIA
FIRST SEMESTER FINAL EXAMINATION – JUNE 2005
AGS 431
SOIL MINERALOGY AND MCROMORPHOLOGY

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

1. Define the following terms: *(8 marks)*

   a) Short range order mineral
   b) Birefringence
   c) Plane of symmetry
   d) Heavy mineral
   e) Complete extinction
   f) Triclinic crystal system
   g) Refractive index
   h) Pleochroism

2. Weathering is an important process responsible for the transformation of minerals in soils. *(8 marks)*

   a) What type of minerals are associated advanced stages of weathering of soils?
   b) What minerals do you expect to find in soils when leaching of Si has progressed to the extent that phyllosilicate minerals are no longer able to form?
   c) What is the name of the chemical process that results in the accumulation of iron and aluminium in soil?
   d) What is siallitization?

   e) Describe the following forms of water with an example for each. *(8 marks)*

   - Water of constitution
   - Coordination water
   - Structural water
   - Zeolite water

3

   a) Briefly describe how you would identify minerals present in the fine earth fraction of a soil, assuming you had an X-ray difractometer, and a petrographic microscope. Outline the methods of sample preparation and how you would identity the minerals using the two techniques. *(10 marks)*

UNIVERSITY OF ZAMBIA
FIRST SEMESTER FINAL EXAMINATION – JUNE 2005
AGS 431
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4

a) Draw the structures of kaolinite and montmorrilonite and clearly indicate the planes in which the various elements occur in the minerals. *(12 marks)*
b) Explain why kaolinite has more variable charge than montmorrilonite, with reference to their structures. *(2 marks)*
c) Describe the differences between the following pairs of minerals in terms of their structure and chemical composition: *(6 marks)*
   - Montmorrilonite and Illite
   - Illite and Muscovite
   - Vermiculite and Chlorite

5

a) What is the influence of chelation on the mobilities of cations in the soil? *(4 marks)*
b) Define the following terms associated with the preparation of clays for analysis by X- ray diffraction: *(6 marks)*
   - Saturation
   - Solvation
   - Heating

6

Sanidine ($K_{0.83}Na_{0.17}AlSi_3O_8$) is a feldspar found in sand fractions of some moderately weathered soils. Below are the crystallographic properties for its unit cell: *(15 marks)*

Axes	Unit length (nm)	Angles	
a	0.878	α	90.00°
b	1.302	β	115.73 °
c	0.718	γ	90.00 °

a) To what crystal system does Sanidine belong? Give reasons to back your answer.
b) Draw a schematic diagram of the unit cell of this crystal, showing the various angles and crystal axes.
c) List the symmetry elements of this crystal and write the abbreviated formula for its symmetry elements.
d) What is the axial ratio of Sanidine?
e) Does this mineral polarize light? Give reasons to back your answer.
f) Is this mineral uniaxial or biaxial? Give reasons to back your answer.
g) What is the thickness of the mineral perpendicular to the (010) plane?

7 Attached is a diffractogram of the clay fraction of a soil from UNZA farm. Given that the X-rays used to analyze the sample were from a Cok_{α} source with a wavelength of 0.179nm.

a) Calculate the d-spacings corresponding to the five peaks on the diffractogram. *(5 marks)*

b) Identify the layer silicate minerals present in this soil sample. Give reasons to support your answer. *(5 marks)*

8 If results of the mineralogical analysis of the soil in question 7 indicate that the silt fraction is dominated by quartz with some muscovite; and that the sand fraction is predominantly composed of quartz, a small amount of the heavy minerals listed below:

List and counts of heavy minerals in sand fraction of soil:

Name	**Formula**	**Number of grains**
Opaque	Unknown	76
Zircon	$ZrSiO_4$	24
Tourmaline	$Na(Mg, Fe)_3Al_6(BO_3)_3Si_5O_{18}(OH)_4$	15
Kyanite	$Al_2Si_2O_5$	20
Sillimanite	$Al_2Si_2O_5$	8
Rutile	TiO_2	10

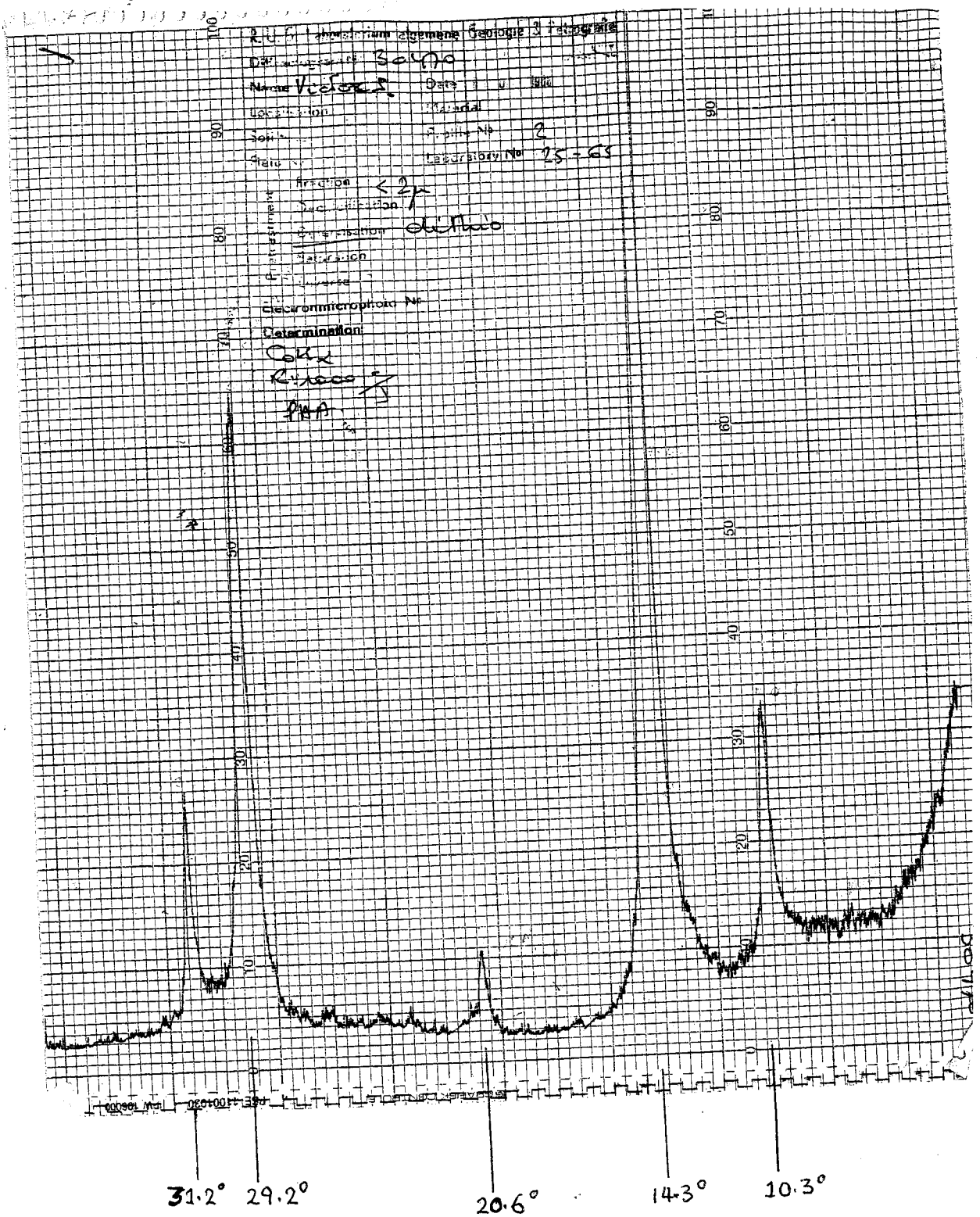
a) What can you infer about the inherent fertility status of this soil? *(3 marks)*

b) Given the grain count of the heavy minerals above answer the following.

i. Calculate the 95 % confidence interval for the proportion of tourmaline grains in the heavy mineral fraction, given that $Z_{0.025}$ is 1.96. *(3 marks)*

ii. How many grains would you have to count to estimate the proportion of zircon grains to within an allowable error of 0.02 at 0.05 level of significance, ($Z_{0.025}$ =1.96). *(4 marks).*

END OF EXAMINATION



Question 7.

X-ray diffractogram for clay sample from UNZA Farm.

3

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATION – JUNE 2005

AGS 441

AGRICULTURAL HYDRAULICS AND HYDROLOGY

TIME: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS, ALL QUESTIONS CARRY EQUAL MARKS. CALCULATORS, GRAPH PAPERS AND WORK SHEETS ARE ALLOWED

Question 1.

Figure 1 presents the Chalimbana River Catchment area which is a sub-catchment of the Zambezi River Basin and drains most parts of Lusaka East including the University Farm at Liempe. The Chalimbana has a catchment area of about 10,000 hectares and is mostly an agricultural catchment and has a large number of streams, dams and reservoirs in the upper and middle reaches of the catchment used mainly for irrigated agriculture on commercial farms. Unfortunately the downstream reaches of the river experiences a lot of water scarcity and is occupied mainly by villagers and small holder farmers.

(a) If the mean annual catchment precipitation is 1000 mm

i. What does that mean?
ii. What three methods can be used to determine precipitation of the Chalimbana Catchment?
iii. Mention one short coming of each of the methods suggested in (ii) above?
iv. If the precipitation duration for the year 2004/2005 was for 120 days, what was the mean rainfall intensity for the season?

(b) If the Evapo-transpiration (ETo) for the catchment is 1800 mm of which 60 % was direct Evaporation

i. What are the two processes that account for Evapo-transpiration?
ii. How is Evapo-transpiration determined?
iii. What was transpiration during the season?
iv. What catchment factors would have affected the value of Evapo-transpiration during the season?
v. What is the implication of the difference between Precipitation and Evapo-transpiration in the Chalimbana River Catchment?

(c) If the run-off for the season was determined to be 300 mm at the bridge near UNZA farm

i. What method would have been used to determine it?
ii. Using the Rationale Method (**i.e. Q = C. i . A, with a C value of 0.25, length of channel of 15, 000 m, and average slope of 0.020**) determine the run-off in the river at the bridge?

(d) If the total infiltration resulting from Precipitation into the sub-surface was 500 mm,

i. What method would be used to determine the entry of precipitation into the soil in the Chalimbana Catchment?
ii. What factors can improve the entry of Precipitation into the root zone?
iii. What would be the peak flow for the Chalimbana catchment and what factors affect it in the catchment?

Question 2.

Figure 2 presents an agro-hydrologic cycle of the Chalimbana River Catchment,

(a) From the concepts and principles of hydrology and **figure 2,**

i. Describe what an agro-hydrologic cycle is?
ii. List the main components of the cycle in (i) above
iii. What would be the main sources of Chalimbana stream flow?

(b) Describe the water balance of the Chalimbana River Catchment,

(c) Given the University Farm, which is within the catchment had during the rain season 2004/2005 recorded Evapo-transpiration of 500 mm, Precipitation of 400 mm, Supplementary Irrigation of 450 mm, Infiltration of 600 mm, Capillary Rise of 50 mm and Beneficial Precipitation of 100 mm and the Chalimbana river stream flow of 250 mm,

i. How much was available for crop production?
ii. How much did both groundwater and run-off benefited?
iii. If during the season, through crop management practices, infiltration improved by 20 %, how much extra would have been available for crop production?
iv. How much would have been lost by run-off in case of (iii) above?

(d) It was reported that in lower reaches of the catchment, there were both an agricultural and a hydrological drought, how would you describe the water resources situation?

(c) If the run-off for the season was determined to be 300 mm at the bridge near UNZA farm

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Question 3.

Figure 3 presents a borehole drilled on one of the farms in the Chalimbana River Catchment to exploit groundwater resources by means of pumping;

(a) Describe two (2) methods that might have been used to,

i. Survey or investigate the location or sitting of the borehole?
ii. to drill the borehole?

(b) From **figure 3,**

i. What method would be used to estimate the yield of the borehole?
ii. What is the radius of influence of the borehole?

(c) From **Figure 3** and given that:

$$\mathbf{A = 2 \Pi r D}$$

$$\mathbf{Q = 2 \Pi r D k (d_h/d_r)}$$

$$\mathbf{K = Q / (2 \Pi D = ln (r_1/r_w) / (h_1-h_w)}$$

i. Estimate the permeability of the borehole given that the rate of pumping, Q, is 2.0 m^3/s? (Given $r_1 = 30$ m, $r_w = 0.15$, $h_1 = 45$ m, $h_w = 30$ m and $D = 7.5$ m)
ii. Describe the relationship between discharge Q and the radius of the borehole?
iii. Describe the steady flow conditions for the borehole?

Question 4.

Figure 4 presents an energy diagram of a pipe water supply,

(a) From the diagram in **figure 4,**

i. Determine the total head of the system and what it means?
ii. How would you apply the Bernoulli's theorem of a liquid in the system?
iii. What is the hydraulic grade line and energy grade line?

(b) Define the following terms used in connection with the flow in the system,

i. Discharge
ii. Uniform flow
iii. Unsteady flow

(c) State the forms of energy a liquid in the system can possess and determine the values of these forms of energy in terms of pressure (P), velocity (V), elevation (Z) and friction (H_L) for the unit weight of a fluid?

(d) What device would be used to determine the discharge (Q) of the system given and what would be its value given that:

$$Q = v\,A$$

(e) What would be the change in Q if the velocity head is reduced by 30 %?

Question 5.

There is no shear force in a liquid at rest but, when in motion, shear forces can be set up due to viscosity and turbulence, which oppose motion, producing a friction effect. Many problems can therefore be solved, at least partially by assuming an ideal frictionless (in viscid) fluid,

(a) Describe two distinct types of flow which occur in,

i. Open channels?
ii. What is a notch? If the discharge over a rectangular notch is given by and is 0.18 m^3/s when the Water Level (WL) is 23 cm above the sill and if the coefficient of Q is 0.6. Calculate the width of the notch required?

Note: $Q = 2/3\ Cd\ B \sqrt{(2g)}\ H^{3/2}$

(b) Use Manning's Formulae and a Monograph provided in **Figure 5** to determine,

i. Channel shape
ii. Satisfactory size

IGNORE THIS QUESTION

Given that

i. a channel is to be designed for a firm clay-loam soil with medium grass cover (200 mm) with n=0.04
ii. a flow of 2.0 m^3/s is the maximum expected
iii. a gradient of is approximately 0.025 m/m
iv. maximum velocity for firm clay loam and medium grass is given as 1.7 m/s

$R = A/P,\ Q = Av,\ v = (1/n)\ R^{2/3} S^{1/2}$

(c) (i) What are three conditions, which a solid body in a liquid can be in equilibrium?

(ii) Given that Chezy formulae;

$$v = C \sqrt{(mi)}$$

(v is the mean velocity, m is the hydraulic mean depth, I is the bed slope of the channel, and C is a resistance coefficient)

i. Find the mean velocity of flow?
ii. Find the discharge when the depth D of water is 1.2 m. If V in the Chezy formulae is 49 in entries?

End of Examination

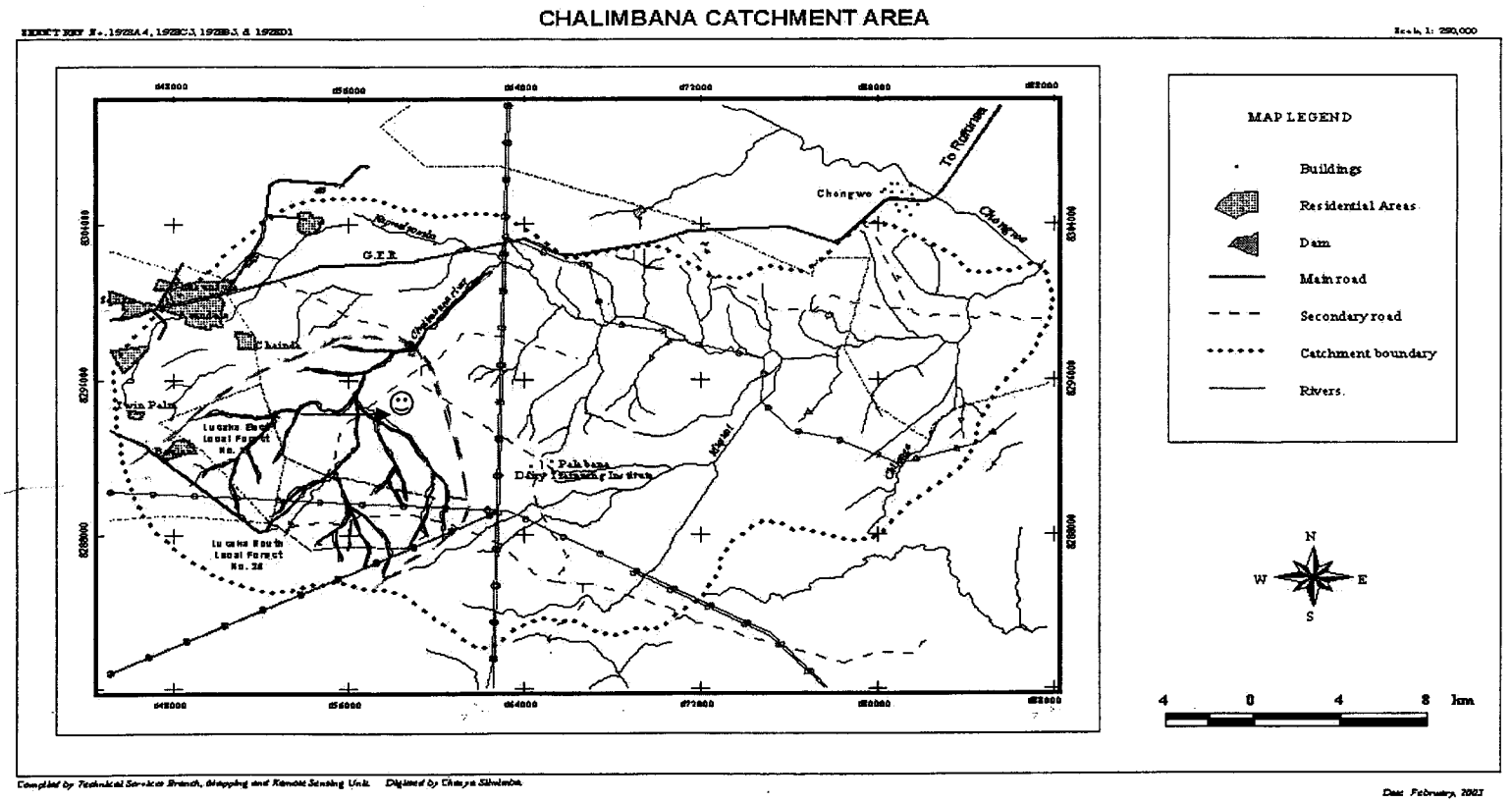
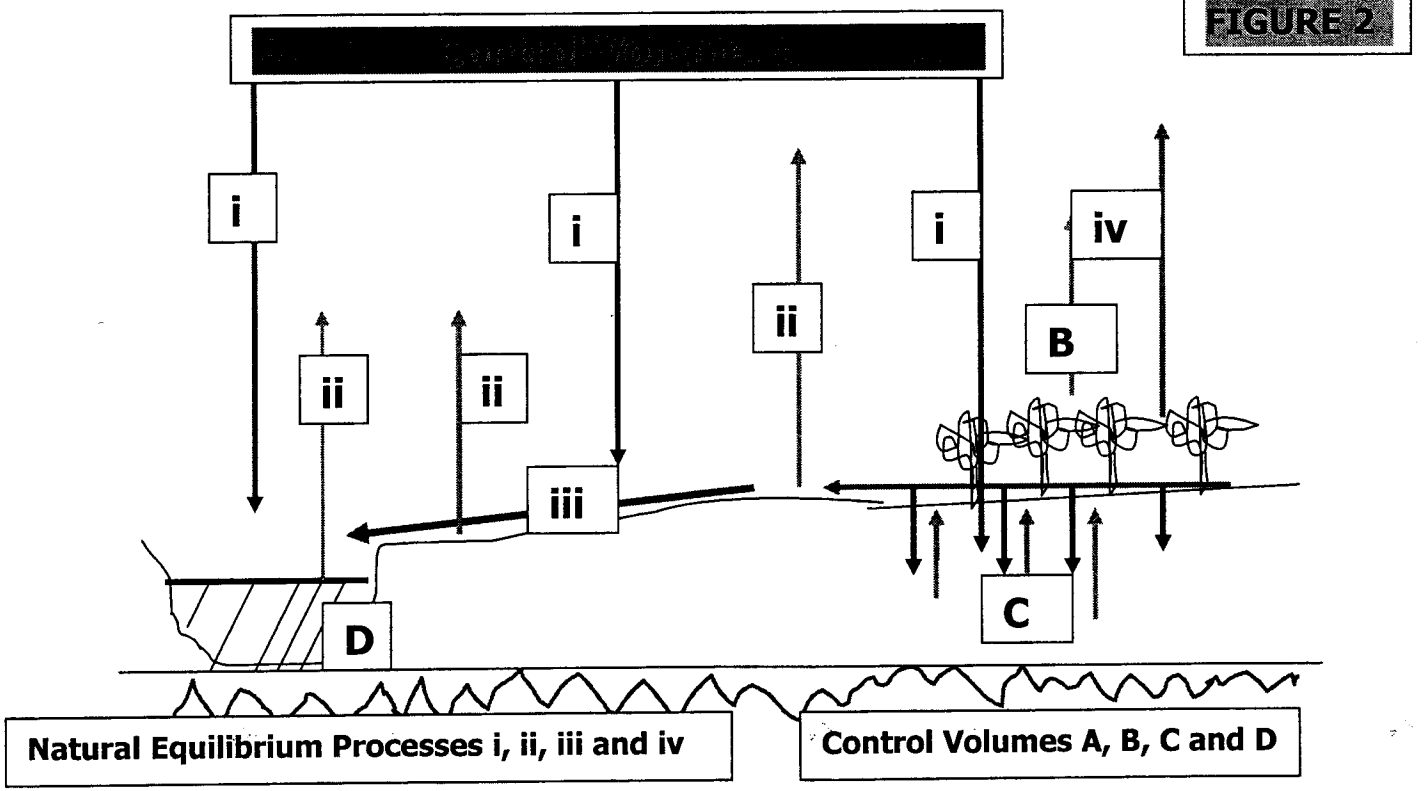


Figure 1. Chalimbana River Catchment of the Zambezi River Basin.

FIGURE 2


i
i
i
iv
ii
ii
ii
B
iii
C
D
Natural Equilibrium Processes i, ii, iii and iv
Control Volumes A, B, C and D

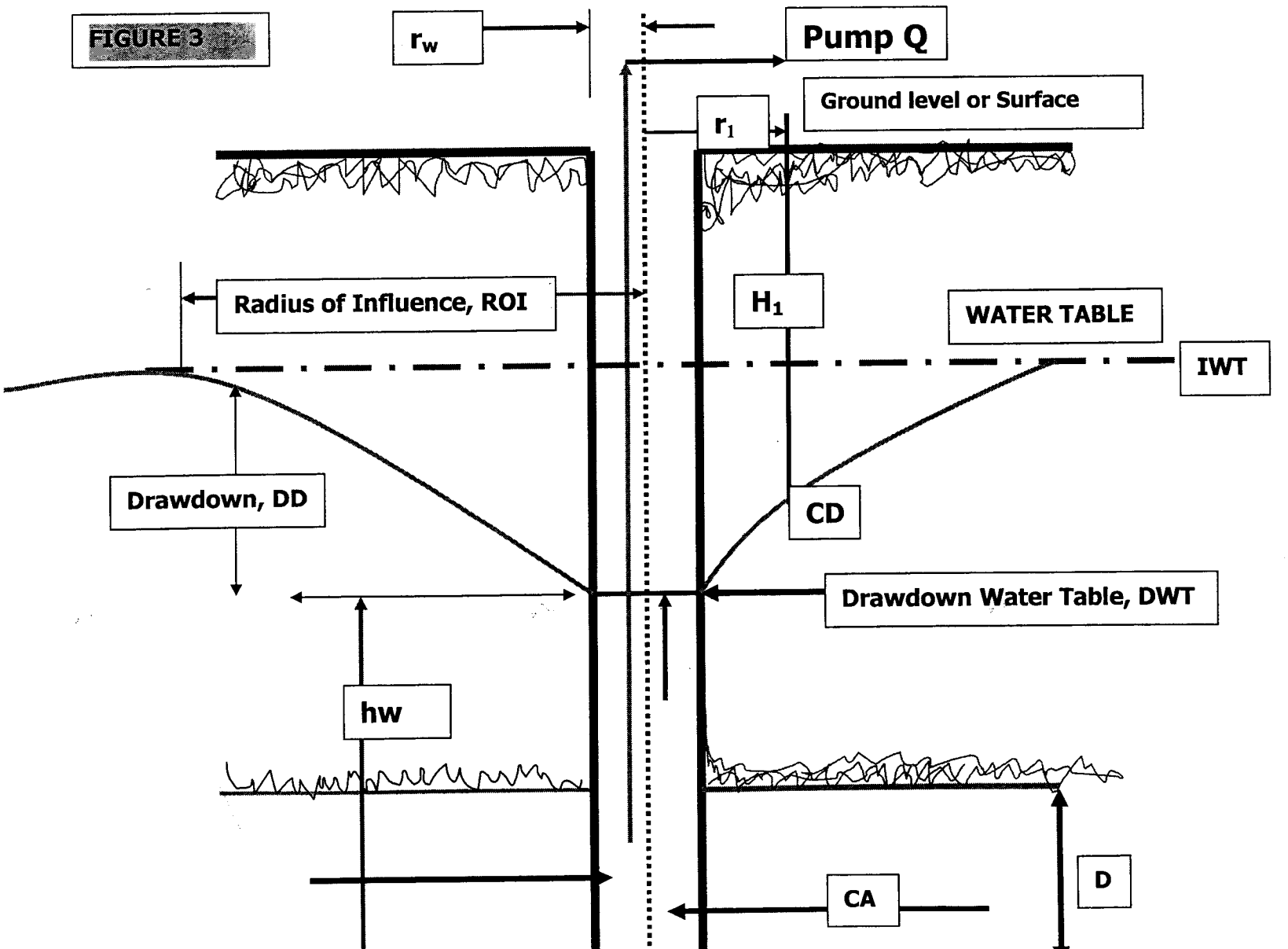


FIGURE 3
r_w
Pump Q
Ground level or Surface
r_1
Radius of Influence, ROI
H_1
WATER TABLE
IWT
Drawdown, DD
CD
Drawdown Water Table, DWT
hw
D
CA

FIGURE 4

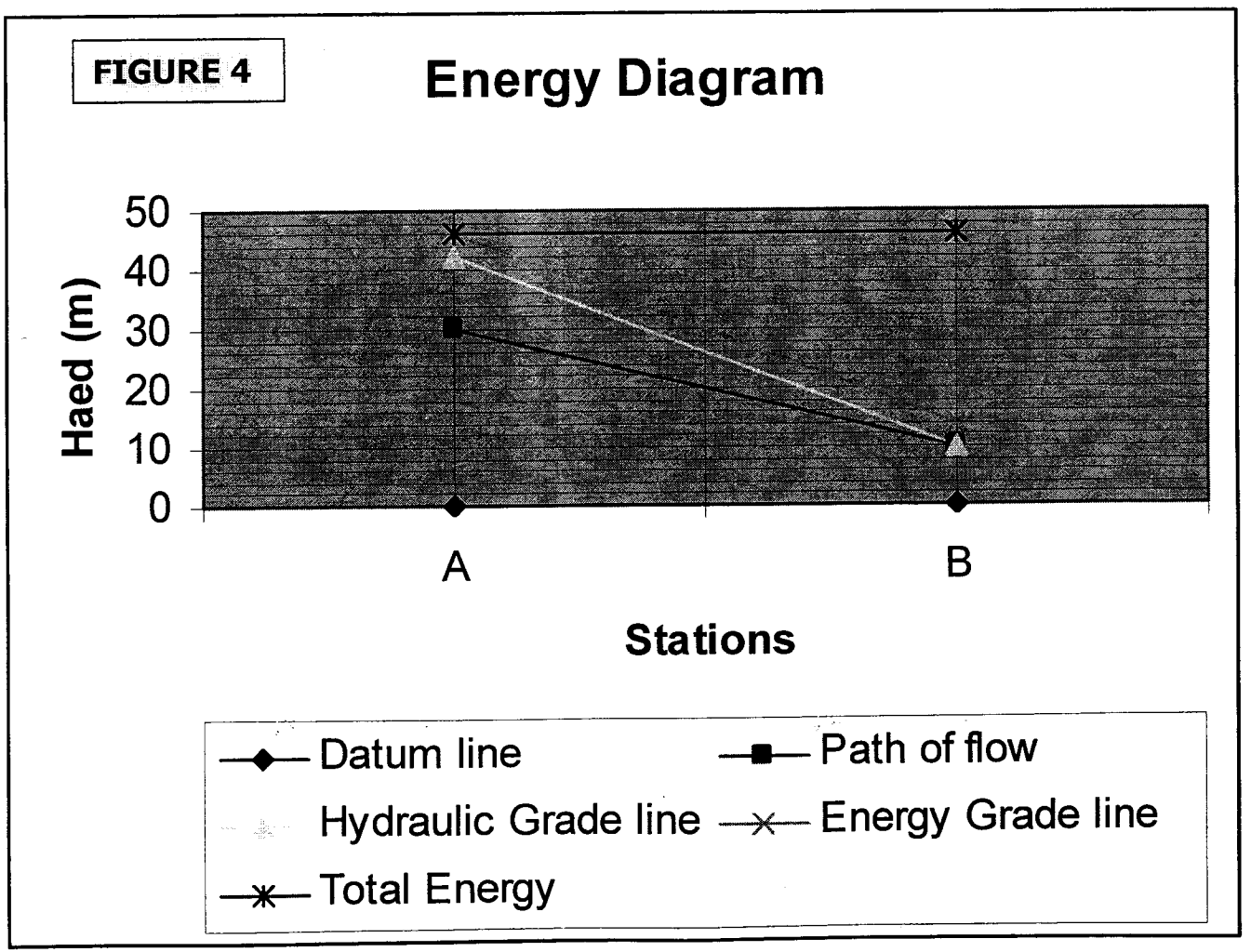

Energy Diagram
50
40
30
20
10
0
Haed (m)
A
B
Stations
Datum line
Path of flow
Hydraulic Grade line
Energy Grade line
Total Energy

FIGURE 5

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS – JUNE 2005

AGS 501

SOIL CHEMISTRY

TIME: THREE HOURS

INSTRUCTION: ANSWER ALL QUESTIONS (POINTS IN PARENTHESIS)

1. Crystalline soil are normally made up of layers:

a. Indicate the two basic building blocks of layer silicates? Use labeled diagram (4 points).
b. How do these building blocks combine in layer silicates? (4 points)
c. Why are soils at an advanced stage of weathering called low activity clay (LAC), variable charge soils (3 points)
d. What are the sources of soil charge in these LACs? (4 points)

2. Define or briefly explain the following terms: (10 points)

a. Surface charge
b. Redox parameter of an equilibrium system
c. Lime requirement
d. Negative adsorption of ions
e. Entropy

3. It is frequently said that Zambia has vast land resource for agriculture. Yet many practitioners of agriculture suggest that low soil productivity is a real challenge to crop production. From a soil chemistry view point, discuss in a generic manner the potential chemistry limitations to the use of soils in the northern and southern parts of Zambia, resulting from, e.g. parent material, climate. What are the possible remedies (and the chemistry of such) to make these soils useable for crop production? (15 points)

4. Use the free-energy data of Appendixes I and II to explore the possible spontaneity of formation of
   a. Gibbsite from aluminium and hydroxyl. (5 points)
   b. Variscite from aluminium, phosphate and water (5 points)

5. A farmer has brought in a soil sample for analysis. Upon reading the pH, you suspect that it is an alkaline soil. When you suspend the soil in water, it remains dispersed and cannot be filtered.

a. What would you do to confirm that this is an alkaline soil? (2 points)
b. If it is an alkaline soil, what is causing it to be dispersed and how? (4 points)
c. Using your understanding of ionic strength, dielectric constant, temperature and valence, among others, how would you go about flocculating this soil suspension? Given that : $DDL = \frac{\sqrt{DKt}}{e\sqrt{8\pi}\sqrt{\mu}}$ (4 points)

where: D = dielectric constant, t = temperature, and μ = ionic strength.

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

a. Define redox. (2 points)
b. Discuss the use of pe in evaluating the redox status of soils. (2 points)
c. Given a wet-land soil and a well drained soil, how would you explain their redox states, pH and the soil weathering stage each might be at? (4 points)
d. Draining submerged soils can make them useful for crop production by raising oxidation status. In the case of acid sulphate soils this is not so. Explain. (2points).

7. A solution contains 0.001 M $CaSO_4$, 0.15 M NaCl and 0.08 M $CaCl_2$.

a. What is the ionic strength of this solution? (3 points)
b. Use the Debye-Hückel limited equation where ions are considered as point charges to calculate the activity of Ca in the solution? (3 points)
c. Use the extended Debye-Hückel equation, given: (4 points)
($A = -0.509$, $B = 0.328 \times 10^8$, $d = 6 \times 10^{-8}$)

8. As you are aware, the ion exchange mechanism of soils is a very important part of their chemistry, given that:

a. Cation exchange process and ion adsorption process are moderated by either ion concentration or ion ratio. Match one with the other and discuss. (5 points).

b. What do you understand by ion selectivity in cation exchange processes, and what are some of the reasons for this? (5 points)

9. When urea is burned at constant pressure it yields gaseous carbon dioxide, liquid water and nitrogen gas. Show that the heat evolved is consistent with the heat of formation values given in Appendixes I and II. (10 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS 2005

AGS 551: PLANNING AND DEVELOPMENT OF IRRIGATION AND DRAINAGE SYSTEMS

TIME: 3 HOURS **MARKS: 100**

INSTRUCTION: ANSWER ALL QUESTIONS. CALCULATORS ALLOWED

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1. Given the following two equations:

(i) $6CO_2 + 6H_2O + sunlight \rightarrow\rightarrow 6O_2 + 6C_6H_{12}O_6$

(ii) $C_6H_{12}O_6 + 6O_2 \rightarrow\rightarrow 6CO_2 + 6H_2O + Energy$

(a) Explain what each of these equations is or represents *(5 marks)*

(b) With respect to irrigation agronomy what do these critical reactions show the role of water to be? *(5 marks)*

(c) Explain the meaning of the word phenology as used in irrigation agronomy. What is its use? *(5 marks)*

(d) When phenology and photosynthetic groups are considered together which are the three most critical environmental characteristics? *(5 marks)*

2. (a) Among the disadvantages of furrow irrigation is the salinity hazard. Explain using diagrams how this hazard manifests itself. *(5 marks)*

(b) Once the test to determine furrow length has been concluded, it is possible to determine the infiltration rate I.R of the soil.

Give the formula which is used to calculate I.R.
If flow measured at flume at 100m is $1.2m^3/hr$ and that at the 1 m flume is $4.5m^3/hr$ what would the I.R be assuming the furrows were 1m wide? *(5 marks)*

(c) Describe two types of turnouts which are commonly used to supply water to furrows from canals. *(5 marks)*

3 (a) In border strip irrigation there is a theoretical maximum length of border that can be irrigated. Although in practice shorter lengths are selected, describe the basis upon which this maximum length determined or postulated. *(5 marks)*

(b) Among variations that may be adopted in border strip irrigation are closed level borders. Describe these. What is the theory that is used to justify or promote this approach? *(5 marks)*

(c) In basin irrigation earth bunds are used to hold water in the basin. There are two criteria used to determine bund size and shape. What are these criteria or considerations? *(5marks)*

(d) You are given the task of constructing basin bunds. What are the steps you would follow and what is involved in each. *(5 marks)*

4. (a) Among the most critical requirements of sprinkle irrigation systems is the provision of appropriate pressure head to each sprinkler in the field. Explain why this is so. *(5 marks)*

(b) Among the critical design consideration of sprinkler irrigation systems is the sprinkler system efficiency. Describe or explain what this system efficiency is explaining in the process Gross water requirement, efficiency of water distribution and sprinkling efficiency. *(5 marks)*

(c) Two types of sprinklers groups A and B are identifiable. Describe group B sprinklers and discuss how they work. This group is not common for large scale field application or use; explain what reasons may mitigate against their popular use. *(5 marks)*

5. (a) Drip or trickle irrigation systems have now become extremely popular. Among the reasons for this popularity are soil moisture related, water saving related, hydraulic control related, irrigation operation related, agronomic related and fertilizer related reasons.

Discuss each of these and explain how they have helped promote form of irrigation. *(6 marks)*

(b) $d = (FC - PWP)xWx(1 - CP)x10R = ETxT$

The above equation is at the core of relations between soil and crop characteristics on one hand and evapotranspiration and irrigation length on the other.

Describe this equation identifying all its components.

The same above equation is modified slightly by the definition and introduction of P to give the following:-

$$d = (FC - PWP) \times W \times (1 - CP) \times 10R \times P = ET \times T$$

Define P and explain the change this modification makes to the final result. *(8 marks)*

6. (a) It is common in developing strategies or mechanism of mitigating against poor drainage to deal with the cases based on the cause of the poor drainage.

Discuss possible strategies/mechanisms for the following causes/conditions.

(i) Spring water due to subsurface flow

(ii) Surface flood due to surface run off and ponding.

(iii) Excess soil moisture due to capillary rise from a high (ground) water table.

(iv) Excess soil moisture resulting from irrigation. *(4 marks)*

(b) $$S = \sqrt{\frac{4K(h^2 + 2ah)}{q}}$$

The above equation is used to calculate the spacing between drains where the field is to be drained by buried drains.

(i) What is this equation called

(ii) Using a diagram or sketch what are the various components in the equation.

(iii) What does the equation predict or show S is to behave like with respect to depth of drains.

(iv) The equation has two critical assumptions what are these? *(8 marks)*

(c) Describe and explain the surface method of bedding for draining the field. Under what condition is it appropriate? *(4 marks)*

END OF EXAM