THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2008 FIRST SEMESTER

1. AGA 221 ANATOMY OF DOMESTIC ANIMALS
2. AGA 311 PRINCIPLES OF NUTRITION
3. AGA 351 ANIMAL SCIENCE FOR ENGINEERS
4. AGA 441 INTROIDUCTIONTO AGRICULTURE
5. AGA 551 TECHNIQUES IN ANIMAL SCIENCE
6. AGA 521 APPLIED ANIMAL REPRODUCTION
7. AGA 531 TOPICS IN ANIMAL NUTRITION
8. AGC 211 PRINCIPLES OF CROP PRODUCTION
9. AGC 411 FIELD CROP PRODUCTION
10. AGC 511 ASPECTS OF CROP PRODUCTION
11. AGC 521 ADVANCED PLANT BREEDING
12. AGE 211 FUNDAMENTALS OF MICRO-ECONOMICS
13. AGE 411 INTRODUCTION TO AGRIBUSINESS MANAGEMENT
14. AGE 421 PRODUCTION ECONOMICS
15. AGE 431 LINEAR PROGRAMMING APPLICATIONS FOR AGRIBUSINESS
16. AGE 531 INTERNATIONAL AGRICULTURAL MARKETS, TRADE AND DEVELOPMENT
17. AGE 511 AGRICULTURAL OGANISATION AND ADMINISTRATION
18. AGE 521 INTRODUCTION TO FARM MANAGEMENT
19. AGE 531 AGRICULTURAL PROJECT PLANNING AND APPRAISAL
20. AGF 211 GENERAL MICROBIOLOGY
21. AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS PRACTICAL
22. AGF 321 FOOD CHEMISTRY PRACTICAL
23. AGF 341 TECHNICAL THERMODYNAMICS
24. AGF 411 UNIT OPERATIONS IN FOOD ENGINEERING
25. AGF 431 FUNDERMENTALS OF BIOCHEMICAL ENGINEERING

26. AGF 441 WATER & FOOD WASTE TREATMENT
27. AGF 511 UNIT OPERATIONS IN FOOD ENGINEERING II
28. AGF 521 PRINCIPLES OF FOOD TECHNOLOGY II
29. AGF 531 TECHNOLOGY OF VEGETABLE PRODUCTS I
30. AGF 541 TECHNOLOGY OF DAILY AND EGG PRODUCTS
31. AGG 311 EXPERIMENTAL DESIGNS & STATISTICS
32. AGS 311 AGROCLIMATOLOGY
33. AGS 431 SOIL MINERALOGY & MICRO MORPHOLOGY
34. AGS441 AGRICULTURAL HYDRAULICS & HYDROLOGY
35. AGS 511 SOIL CHEMISTRY
36. AGS 531 LAND EVALUATION & IMPROVEMENT
37. EA 311 FARM POWER & MACHINERY
38. AGS 551 PLANNING IRRIGATION & DRAINAGE

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

ANATOMY OF DOMESTIC ANIMALS
AGA 211 FINAL EXAMINATION

First Semester 2008

INSTRUCTIONS:

1) ANSWER ALL QUESTIONS IN **BOTH** SECTIONS.
2) WRITE EACH SECTION IN SEPARATE BOOKLETS
3) TIME ALLOWED: THREE HOURS

SECTION ONE

QUESTION 1

Anatomy is description of form and structure of body and body parts. Knowledge of anatomy helps in understanding function of that part.

a) How is anatomy studied? (6)
b) Briefly describe the criteria for classification of epithelium? (12)
c) Describe 4 types of Epithelium (12)
d) For each epithelium described above, give its functions (8)
e) For each epithelium described above, give examples where such epithelia are found in the body? (4)

QUESTION 2

Respiration functions in exchange of gases in the body.

a) Draw and label the upper and lower respiratory tract (15)
b) Describe the respiratory process (18)

QUESTION 3

Write short notes on the following. (25)

i. Bone formation
ii. Cardiac muscle
iii. Vertebral Formula of a pig.
iv. Muscles of the forelimbs
v. Areolar Connective tissue

SECTION TWO

QUESTION 1 (18 Points)

Define the following geographical terms used in the study of anatomy:

(a) Cranial and Anterior
(b) Caudal and Posterior
(c) Median plane
(d) Medial
(e) Lateral
(f) Dorsal
(g) Ventral
(h) Proximal
(i) Distal

QUESTION 2 (41 Points)

(a) Draw a sketch of the mammalian brain and label the following:

- Cerebrum
- Cerebellum
- Thalamus
- Hypothalamus
- Hypophysis
- Mammillary body
- Optic chiasm
- Pons

(b) Besides containing many fiber tracts from the spinal cord, the brain stem is the site of nuclei for cranial nerves, including those termed V, VI, VII, IX, X, XI, and XII. What are the names of these nerves?

(c) Describe the meninges of the brain.

(d) With the help of a sketch, describe the arrangement of spinal nerves in a domestic species with the following vertebral column: $\mathbf{C_{14}T_7LS_{14}Cd_6}$

(e) What species is this?

QUESTION 3 (25 Points)

(a) Sketch the female reproductive system showing the following parts:

- Ovary
- Infundibulum
- Ampulla
- Isthmus
- Uterine horn
- Uterus body
- Cervix
- Vagina
- Vulva

(b) Compare the cervix of a gilt with that of a heifer

(c) Draw the diagram of a mammalian ovary showing progressive stages in the differentiation of a follicle up to rupturing and formation of a corpus luteum.

QUESTION 4 (16 Points)
Draw the basic functional unit of a kidney, lebelling all the major parts.

END OF EXAMINATION

THANK YOU FOR BEING WITH US IN THE COURSE. WE WISH YOU A VERY MERRY CHRISTMAS & HAPPY NEW YEAR

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

COURSE AGA 311: PRINCIPLES OF NUTRITION

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS TO CANDIDATES:

i. **Answer six (6) questions: any five (5) questions in Section A and only one question in Section B.**
ii. **All questions carry equal marks**
iii. **Write the answer for Section B in a separate answer book.**

SECTION A.

Q1.

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

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

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

Glyceraldehyde 3-phosphate + NAD^+ + Pi $\leftrightarrow$ 1,3-Biphosphoglycerate + NADH + H^+

Briefly explain how the reduced Nicotinamide Adenine Dinucleotide (NADH + H^+) is oxidized to regenerate NAD^+ under aerobic glycolysis and under anaerobic glycolysis, respectively.

Q2.

i. Name four modified amino acids, and indicate the function of each mentioned amino acid in the animal body. Give the name of the precursor amino acid for each of the mentioned modified amino acids.
ii. Discuss the digestion of proteins in the non-ruminant animal.
iii. What is the fate of the absorbed amino acids in the animal body?

Q3.

i. Name the essential fatty acids and their dietary sources.
ii. Give five essential fatty acid deficiency symptoms in farm animals.
iii. With the aid of flow diagrams outline de-novo synthesis of fatty acids. Explain how fatty acid elongation and desaturation occur, indicating why essential fatty acids cannot be synthesized by mammals and therefore, have to be provided in the diet.

Q4. Vitamins A and D are fat soluble vitamins required by farm animals for normal body function. Give the following details for either Vitamin A or Vitamin D only:

i. The functional forms of the vitamin of your choice.
ii. The precursor compounds for the vitamin of your choice.
iii. Four physiological functions of the vitamin of your choice.
iv. Three deficiency symptoms of the vitamin of your choice and the conditions under which they are likely to occur in a farm situation.

Q5.

a. List any 5 (five) B Complex Vitamins.

i. Give the full names of the coenzymes in which the listed vitamins occur in the animal body.

ii. Write in brief, the function of each mentioned coenzyme in metabolism.

iii. Give two dietary sources of each of the five water-soluble vitamins mentioned above.

b. Name two dietary sources of any three macrominerals and any two microminerals.

Q6. Write briefly on the following:

i. The factors that affect the digestibility of feeds.

ii. Heat increment of feeds

iii. Biological value of proteins

iv. Interactions of nutrition with disease and parasite infestations in the animal body.

v. Bile acids

SECTION B

Q1. Volatile fatty acids (VFAs) are said to be the main source of energy for ruminants. Explain how carbohydrates and proteins are converted to VFAs and how these VFAs are used as a source of energy. When are the VFAs inadequate to supply energy needs and how is this problem overcome?

Q2. Despite the large biomass of protozoa in the rumen, their role in microbial fermentation is sometimes in doubt. Why is this so and how can their role be demonstrated in the reticulo-rumen?

~END OF EXAMINATION~

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGA 351 – ANIMAL SCIENCE FOR ENGINEERS

TIME : THREE (3) HOURS
INSTRUCTIONS : ATTEMPT ALL QUESTIONS

PART I

1. Describe the structure of a cow's stomach explaining how it functions in the process. (15 marks)

2. Explain the differences in the anatomy and functioning of avian and mammalian respiratory systems. (15 marks)

3. Identify and describe the anti-nutritional factors associated with the feed ingredients listed below giving their chemical nature, their mechanism of interference in nutrition, the resulting effects and ways of avoiding their negative effects in livestock feeding.
   a. Cassava
   b. Sorghum
   c. Soyabean

   (15 marks)

4. Discuss urea as a feed ingredient. (15 marks)

PART II

5. Answer the following:
   a. Define culling
   b. What are the factors to consider when culling layers?
   c. What is the best time to breed beef animals under Zambian conditions and explain why?

   (20 marks)

6. Answer the following:
   a. What are the factors to consider before embarking on pig farming?
   b. Discuss the management of litter from farrowing to weaning.
   c. Why would a farmer prefer rearing goats to other types of livestock?

   (20 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGA 441 INTRODUCTION TO AQUACULTURE

TIME: THREE HOURS

INSTRUCTIONS: ANSWER **ALL** QUESTIONS **IN SECTION A** AND **ONE** QUESTION IN **SECTION B**. USE DIAGRAMS AND EXAMPLES AS APPROPRIATE IN YOR ANSWERS

SECTION A

1 Describe and discuss the following terms and concepts and explain how each term relates to the life cycle and growth or development of fish:

a) Condition factor;
b) Growth coefficient (k);
c) Asymptotic weight (W_{oo});
d) Gonad maturity stage; and
e) Age at maturity.

2 a) Discuss methods that are used to estimate fish growth highlighting Advantages and limitations of each method.

b) Suppose total length of the fish when scale sample was obtained is 500 mm, total scale radius is 10 mm and radius of the first annulus, when the first annual ring was formed is 2 mm. and the second one is 4 mm. Estimate the total length of the fish when the first and second annulus were formed.

c) Describe and contrast the growth coefficient (k) and instantaneous growth rate (G)

Please Turn Over

3 The family Cichlidae is important in many parts of the world including Sub-Sahara Africa.

a) Describe the main characteristics and distinguishing features of the family Cichlidae

b) Describe the main subgroups of the family Cichlidae.

c) Name any four Cichlid species that are common in Zambian water bodies and indicate the main features used in their identification.

d) Which sub-group of the family Cichlidae is commonly used in aquaculture and give reasons why species of the sub-group are preferred in fish farming?

SECTION B

4 Describe and discuss using diagrams as appropriated, main shapes of fish that used in the description and classification of fish.

5 i) List sources and uses of dissolved oxygen in different parts or sections of aquatic environments.

ii) Explain effect of increase in water temperature on fish in relation to availability of dissolved oxygen.

6 Earthen ponds used in fish farming are usually not deep, 0.5 to 1.5 metres deep. Based on physical chemical and biological characteristics that influence productivity of aquatic environments, discuss the reasons for not making fish ponds deep

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END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS –NOVEMBER 2008

AGA 511 - TECHNIQUES IN ANIMAL SCIENCE

TIME: **3 HRS**

INSTRUCTIONS: **ANSWER EACH SECTION IN A SEPARATE ANSWER BOOK.**

SECTION A

1. Answer all parts (20 points)

   a. Define and contrast the following terms
      i. Project systems cycle
      ii. Business plan
      iii. Project proposal

   b. You have been hired as a consultant by a Non Governmental Organization (NGO) to prepare a proposal and its business plan to justify to a donor the benefit of giving 50 village hens to each of the 600 small scale farmer in Kamaila for them to attain the Millennium Development Goals by 2015.
      i. Provide an outline of the proposal and business plan and
      ii. Indicate the content in point form without explanations

   c. Briefly explain why most business plans fail.

SECTION B

Answer one question from this section.

2.
   i. Define feeding standards and write on the considerations made in applying feeding standards for lactation.
   ii. Several changes take place in stored feed samples. Explain how these changes occur and their effect on the results of analysis of affected samples.

3. Imagine that the Ministry of Agriculture has been directed by government to re-establish national beef ranches. You have been asked, as Animal Production Officer based at headquarters, to design the pilot beef ranch in the re-establishment exercise. Write on the factors you would consider in setting up the pilot beef ranch.

SECTION C

4. a. Define blood.
   b. Name the constituents of blood and indicate their functions.
   c. Mention and explain the methods of collecting blood from farm animals

SECTION D

5. Body condition scoring is useful in monitoring the extent to which cattle are affected by nutrition, disease and other environmental factors.

a) Condition Scoring is a subjective assessment, give reasons why you would personally prefer to use it instead measuring weight changes in cattle?

b) Give reasons why you would personally not want to physically measure weight changes in beef cattle?

c) What would be the condition score of beef cattle in Figures I and II? Discuss the factors that made you give the scores.

Figure I

Figure II

6. Following your graduation you decided to develop a farm you inherited from your late grandfather instead of looking for a job. You have at your disposal oxen and cows to use for the provision of animal draft power. How would you go about making the decision regarding the economic use of these animal types in the development of the farm?

SECTION E

7. In any Scientific Experimentation, the scientist wishes to estimate treatment effects as accurately as possible. Error control is hence a prime consideration in the design and conduct of an experiment.

   Discuss the various error control measures used at:

   a) Experimental design level

   b) Experimental set-up and data collection and analysis stages.

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS - DECEMBER 2008

AGA 521 – APPLIED ANIMAL REPRODUCTION

TIME: 3 HOURS

INSTRUCTIONS: ANSWER ANY FIVE (5) QUESTIONS. ANSWER EACH SECTION IN A SEPARATE ANSWER BOOK.

Section A

1. Read each question carefully! Answer as stated and related to this course.

   For each of the phenomena listed, give the following information:

   a. Physiological status of the animal (e.g. estrual, metestrus I or II, pregnant, etc).
   b. Factors involved (e.g. hormones, anatomical structures, etc).
   c. Pathways involved (e.g. if the result involves two or more structures, show how).

A. A blood sample from a cow was analyzed for hormone effect levels and the following was found:

Below Dominance	Dominant
LH	Estrogen
Progesterone	FSH
	$PGF2_{\alpha}$

B. The ovaries were removed from the cow and a general examination (no microscope) was carried out. What structures were observed and what specific observations confirmed the cow's physiological status indicated by the hormone assay in "A"?

2. Give a 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. A cow with endometritis (inflammation of the endometrium) has not been in heat for more than 40 days (nutrition has been optimum).

b. A ewe did not show heat with the first ovulation at the start of the breeding season.

c. The follicle only ruptures in the ovulation fossa of a mare, but occurs anywhere on the surface of the ovary of the sow.

d. A sow aborted after having only 3 ova fertilized

3. Give a possible environmental-neural-endocrine interaction for the following situations; be as complete as possible in listing all steps and show if the effect is positive or negative (include increases or decreases).

a. A mare is in seasonal anestrus. Show a feasible pathway of events that lead to cycling. Follow to complete expression of estrus and ovulation.

b. A sow is in lactational anestrus. Show a possible interaction that leads to lactation, but lack of cycling.

4. a. Tell how you can synchronize estrus in a group of sheep that were in anestrus using vaginal pessaries (sponges) impregnated with progesterone, prostaglandin, and gonadotropins. What would you do to make sure the ewes show signs of estrus?

b. Describe how you can synchronize a herd of lactating cows with just $PGF_{2\alpha}$, beginning today, December 5. What would you do to increase the degree of synchronization most effectively? Give dates of injections and date of synchronization.

Section B

5. a. Outline the role of artificial insemination in the improvement of the livestock industry. What are the challenges of the livestock industry in Zambia as far as the use of AI is concerned?

b. Semen collected from a bull showed the following characteristics:

Semen evaluation showed the following;

Volume of semen	9ml
Concentration	900×10^6
Motility	80%
Normal cells%	95%

Calculate the following;

i. The total number of cells in the ejaculate.
ii. Total Live cells.
iii. Total Live normal cells.
iv. Number of ml of extender for
    a) semen to be used unfrozen,
    b) semen to be frozen

6. List and explain the causes of reproductive failure in farm animals

THE UNIVERSITY OF ZAMBIA

THE SCHOOL OF AGRICULTURAL SCIENCES

2008 ACADEMIC YEAR – FIRST SEMESTER FINAL EXAMINATIONS

COURSE AGA 531 – TOPICS IN ANIMAL NUTRITION

TIME ALLOWED: THREE (3) HOURS ONLY

INSTRUCTIONS TO CANDIDATES:

a) Each Section carries equal marks (50%).
b) Answer each Section in separate answer books.
c) Answer all Questions in Section A (Non-ruminant Nutrition).
d) Answer Question 5 and any three others from Section B (Ruminant Nutrition).

SECTION A (NON-RUMINANT NUTRITION):

Q. 1 Answer (a) and any three of the following:

a. Why is water said to be an essential nutrient in livestock production? Explain your answer.

b. (i) What is the glycogenolytic function of the liver? (ii) How is it controlled? (iii) What happens when control fails?

c. The major cost of non-ruminant production is feed. It has also been established that feed efficiency is effected (realized) at both physical and cellular level. Illustrate the energy balance and efficiency of glucose utilization by a non-ruminant animal at neutral pH and room temperature.

d. Lipids are a component of an animal's diet. Briefly outline the role they play in both the diet and animal body.

e. In a flow chart, illustrate (i) the absorption and (ii) storage of fat in the non-ruminant animal.

(15 Marks)

Q. 2 Answer one of the following:

a. Summarize the direct and indirect effects of environment and their consequences on egg and meat poultry production. **OR**

b. Briefly explain why paying particular attention to housing of hybrid poultry in hot climates is important? What are the advantages and disadvantages of rearing indigenous breeds?

(10 Marks)

Q. 3 Answer one of the following: 10 Points

a. Define the different pig rearing production systems and highlight their advantages and disadvantages. **OR**

b. What are the factors that influence the efficiency of Net Energy (NE) utilization in the pig. Contrast the energy requirements in the pregnant to that of the lactating sow.

(10 Marks)

Q. 4 In weaner pigs, feed intake increases linearly during post weaning (except 24 hours post weaning when the weaner is off feed or eats little due to stress of being weaned).

a. Calculate the digestible energy (DE kcal/day) for a weaned pig weighing 15kg. Given that the feed energy constant = 455.5, fecal Energy constant = 9.46 and R^2= .92

b. A small scale farmer has contracted you to formulate a point of lay layer ration for her poultry unit.

i. What assumptions would you make based on the nutrient requirements of laying hens?
ii. Formulate a point of lay pullet ration that is balanced for Energy, Crude protein, Calcium and Phosphorus.

Given that the farmer has access to solvent extracted soybean meal (45% CP, 2200 kcal ME), maize meal (8% CP, 3400kcal ME), Limestone (38% Ca) and Dicalcium Phosphate (20% Ca, 18% phosphorus).

(15 Marks)

SECTION A (RUMINANT NUTRITION):

Q. 5 The Liempe University Farm would like to compound a feedlot ration for 304 steers by making use of readily available feedstuffs in order to reduce the costs of production. Tabulated below are the results of the analyses of the feedstuffs available on the farm that the Farm Manager obtained from the Animal Science Department laboratory:

FEED	DM%	DCP%	TDN%	Ca	P
Rhodes/Silver leaf	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	88	25.0	65	0.69	0.06

Other available feedstuffs at Liempe Farm are:

Maize Meal	89	10.0	88	0.03	0.31
Groundnut Meal	95	43.0	90	0.18	3.62
Groundnut Haulms	87	12.0	62	0.07	0.17
Lucerne Hay	90	15.0	60	0.27	0.03

Formulate a dry season feedlot ration for the beef steers, with the help of the Pearson Square. The feedlot ration must contain 14% DCP and 70% TDN and must include 15% Rhodes Grass and Silver leaf Hay, 10% Maize Bran, 5% Sugarcane Molasses, 5% Soyabean Straw and 1% Mineral Premix, 1% Salt, 1% Dicalcium Phosphate, on dry matter basis.

(20 Marks)

Q. 6 a) Using the rapid formulation of forage and compound feed calculate the forage dry matter intake and the compound feed intake that should be provided to a 600 kg Friesian dairy cow in mid-lactation producing 25 kg milk per day containing 3.5% butterfat and 8.4% solids-not-fat given that only Maize Silage (containing 9 MJ ME/kg DM) and Dairy Meal or Compound Feed (containing 12.5 MJ ME/kg DM) are available.

b) If the Friesian cow in 1 a) above was actually in early lactation and was losing 0.5 kg per day, calculate the forage dry matter intake and the compound feed intake requirements.

e) If the Friesian cow in 1 a) above was actually in late lactation and was gaining 0.5 kg per day, calculate the forage dry matter intake and the compound feed intake requirements.

(10 Marks)

Q. 7 Ruminant animals, unlike monogastric animals, are able to subsist entirely on vegetative materials. Discuss this statement highlighting the functions of micro-organisms in the ruminant stomach and the symbiotic relationships between the ruminant animal and microbes.

(10 Marks)

Q. 8 a) Discuss the causes of Acetonaemia, the methods of prevention and treatment on a farm of your choice;

b) How much is an Angoni steer weighing 375 kg expected to grow if it is fed on a daily ration consisting of the following feed-stuffs?

- ✓ 9.5 kg Sorghum Silage (300k/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)

(10 Marks)

Q. 9 Write notes on cyanogenetic glucosides and glucosinolates.

(10 Marks)

The following may be used to answer the questions:

i. $EVl = 0.0386\ BF + 0.0205\ SNF - 0.236$

ii. $Mm = 8.3 + 0.091\ W$

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

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

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

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

vii. $Ml = \dfrac{EVl \times 1.05}{0.62}$

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

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF CROP SCIENCE

FIRST SEMESTER EXAMINATIONS, 26TH NOVEMBER 2008

AGC 211: PRINCIPLES OF CROP PRODUCTION

TIME ALLOWED: 3 HOURS **TIME: 09:00 – 12:00 HOURS**

INSTRUCTIONS

(1) Answer all Questions

(2) Marks as indicated

		Marks
Question 1		
a)	Why is Millennium Goal 1 not likely to be achieved in Zambia?	2
b)	What are the basic tenets of Conservation farming as advocated in Zambia?	2
c)	Why is the toxic effect of Alumunium in acidic soils greater at higher (4.5) pH than at a lower (4.0) pH.	2
d)	Molybdenum is an important component of 2 major enzyme systems, which are these? What are their functions?	2
e)	In determining reference evapotranspiration what do the terms Ra, Rn, Rs refer to?	2
f)	Explain why soil measurements with a Neutron probe cannot be determined at a depth of less than 10 cm	2
g)	Briefly describe the functions of phytohormones in plants.	3
	Sub total	**15**
Question 2		
a)	Define soil water potential. What is the advantage of using the concept of soil water potential?	10
b)	The rainfall over 10-day period was 13 mm. A farmer has irrigated her crop with 9 mm water. Assuming a drainage of 2 mm and the water in the soil profile decreased by 5 mm, what was the average evapotranspiration?	15
	Sub total	**25**

Question 3		Marks
i)	Define Agroforestry.	3
ii)	What are the advantages of Agroforestry?	3
iii)	Explain how improved fallows contribute to increased maize yields.	4
iv)	Given the soil NO_3 content profile of a maize crop and three agroforestry species shown in Figure 1, describe the pattern of soil NO_3 movement and accumulation and significance in uptake and crop growth.	5
v)	What kind of source of plant derived N is illustrated in Figure 2? Describe the mineralization pattern and factors controlling the dynamics of mineralization?	5
	Sub total	**20**

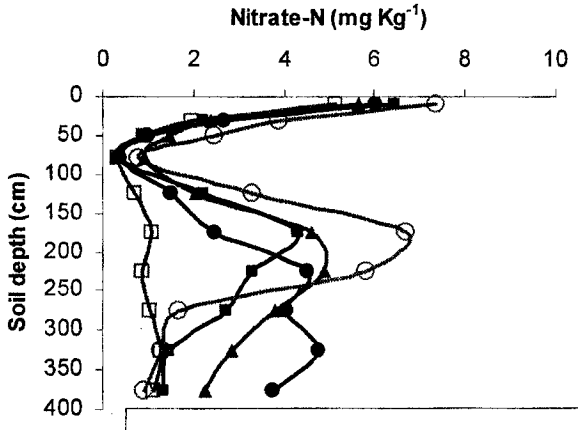


Figure 1: soil NO_3 content profile of a maize crop and three agroforestry species

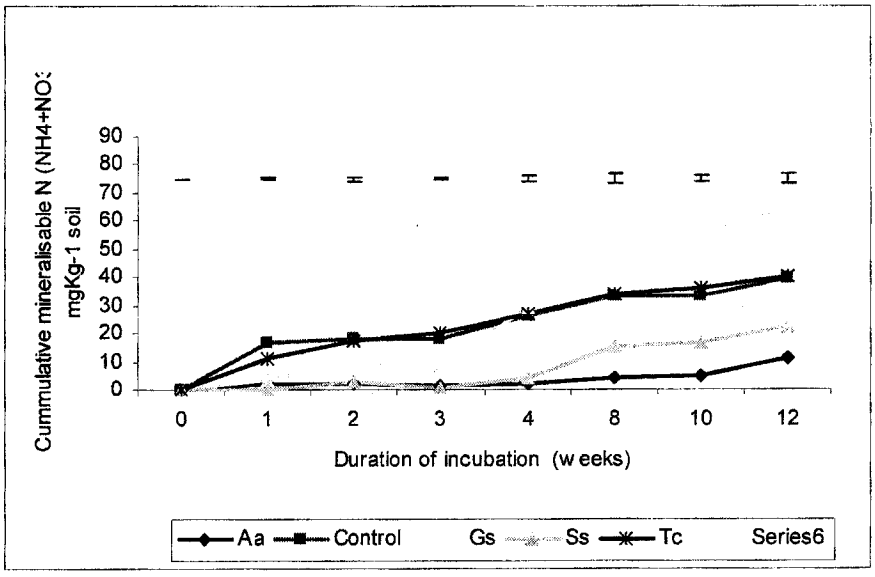


Figure 2: Cumulative Mineralisable Total N (NO_3 + NH_4) Patterns of Release during Incubation

Question 4		Marks
	What is:	
a) i)	Soil nutrient depletion? How was soil nutrient depletion effectively demonstrated?	4
ii)	Nutrient buffer capacity?	2
iii)	Nutrient absorbing power?	2
b)	What factors control nutrient uptake?	5
c)	Describe the main mechanisms and their significance in plant nutrient uptake	7
	Sub total	**20**

Question 5		Marks
	The families Fabaceae and Euphobiaceae are important families in the economy of the country.	
i)	Describe the characteristic features of the families.	6
ii)	Name 2 crops belonging to the family Fabaceae which are grown by small-scale farmers in dry areas of the country. Similarly name 2 crops belonging to the family Euphobiaceae. One of the 2 crops should be of increasing importantance as a biofuel crop.	2
iii)	What are the scientific names and places of origin of the above mentioned 4 crops?	2
iv)	Describe at least 4 optimum conditions of growth of the above mentioned 4 crops.	6
v)	Describe at least 5 uses of economic importance of the above mentioned 4 crops.	4
	Sub total	**20**

END OF EXAM

University of Zambia

School of Agricultural Sciences

Fourth Year Examinations for Bachelor of Agricultural Sciences

AGC 411 Field Crop Production

First Semester 2008

Date: 5th December 2008 **Time: 14.00 – 17.00 hrs**

1. In groundnut production, spacing is related to growth habit.
   a) Describe the two (2) different growth habits in groundnuts? **4 marks**
   b) Give an example of a groundnut variety and the spacing for the growth habit of that variety. **3 marks**

2. The following relate to wheat production.
   a) In commercial production, which crop follows wheat in a rotation? **1 mark**
   b) Which is the major weed problem under such a rotation? **1 mark**
   c) Where does this weed problem arise from? Give relevant examples. **6 marks**
   d) What method of land preparation is practiced in this rotation? **1 mark**
   e) List three (3) advantages of practicing this method of land preparation. **3 marks**
   f) Describe the process of planting in this rotation. **2 marks**

3. Describe stooking in maize bringing out the purpose and benefits of this practice. **4 marks**

4. a) When is cassava harvested? **2 marks**
   b) When is best time to harvest cassava and why? **8 marks**

5. Under the Chitemene system (slash and burn method) of cultivation:
   a) How is finger millet planted? **2 marks**
   b) What are the benefits of growing the crop under this method? **4 marks**

6. You have recently been appointed as an Agricultural Officer for Chinsali District. A youth group would like to engage in groundnut production and has approached you.
   a) What soils would you recommend for groundnuts? **5 marks**
   b) What soils would you not recommend for groundnuts? Why? What would you advise a farmer with such soils? **13 marks**

7. In cassava, biological control is practiced using natural enemies.
   a) Name the pest and give its scientific name. **2 marks**
   b) Describe the symptoms of infestation? **8 marks**
   c) How much yield loss can be expected when the crop is attacked by this pest? **1 mark**
   d) What factors determine the magnitude of yield loss? **5 marks**
   e) In order to avoid this pest, which preventive measures are used? **4 marks**

8. In conservation farming:
   a) What are the dimensions of a planting basin? **1.5 marks**
   b) How many basins are dug per hectare? **1 mark**
   c) What implement is used to make these basins? **1 mark**
   d) How many seeds of sunflower and sorghum are planted in a basin? **1.5 marks**
   e) When should weeding begin? **1 mark**

End of Examination

The University of Zambia
School of Agricultural Sciences
Department of Crop Science
Fifth Year Examinations for the Bachelor of Agricultural Sciences
AGC 511: Aspects of Crop Production
Second Semester 2008

Date: 24 November, 2008 **Time: 09.00 – 12.00hrs**

Instructions

1. **Answer all questions**
2. **Marks as indicated**

Q1. Water stress has serious negative effects on crop productivity. Using your knowledge of agronomy, answer the following:

a. Explain the effects of water stress on crop productivity 6
b. How can this type of stress be mitigated against 6

Q2. a. Define Conservation Agriculture (CA)? 3
b. What are the 3 cornerstones of Conservation Agriculture 3
c. Explain the principles underlying the cornerstones identified in Q5b above. 6

Q3. Explain the influence of the following factors on crop production

a. K-Value 2
b. Transpiration coefficient (TC) 2
c. Light transmission (t) 2
d. Fractional Interception (f) 2
e. Leaf Area Index (LAI) 2

Q4. Assuming the following in spring wheat:

(i) Total yield @ 13% moisture = 20MT
(ii) Total energy received per hectare over a 110-day growing period = 22,243,230,000KJ/Ha
(iii) Energy conversion: 15,792KJ/Kg

Calculate the following clearly showing steps involved:

a. Ash content 3
b. Respiratory losses 3
c. Total energy produced by crop 3
d. Photosynthetic efficiency of the crop 3

Q5.a. Explain the implications of not following recommended plant populations 8
b. Explain the three scenarios expected in a crop mixture experiencing competition 6

END OF EXAMINATION

UNIVESITY OF ZAMBIA

SCHOOL OF AGRICLUTURAL SCIENCES

CROP SCIENCE DEPARTMENT

UNIVERSITY EXAMINATIONS

AGC 521 ADVANCED PLANT BREEDING DATE: NOVEMBER 2008

VENUE: OTHER ROOMS TIME 09:00-12:00

INSTRUCTIONS

Answer Question No. 1 and any other THREE. Points for each question are indicated in brackets.

TIME: 3 hours

Q. 1 (a) The following data were provided from genetic analysis study. Additional information was also provided in terms of expectations and estimates. You are requested to estimate the heritability values in the narrow sense and broad sense context.

Item	P_1	P_2	F_1	F_2	B_1	B_2
Means	12.99	27.61	18.45	21.20	15.63	23.38
Numbers	159	148	171	552	326	314
Variance (V)	11.036	10.320	5.237	40.350	17.352	34.288

Expectations:

$V_{F2} = V_A + V_D + V_E$

$V_{B1} + V_{B2} = V_A + 2V_D + 2V_E$

Estimates:

$V_E = (V_{P1} + V_{P2} + V_{F1} \div 3$

$V_{F2} = V_{F2}$

(25 points)

Q. 1 (b) The following represent a large population in random mating.

		Genotypes representing female parents		
Genotypes representing male parents		*AA*	*Aa*	*aa*
	AA			
	Aa			
	aa			

a. Fill in the resultant genotypes of such a mating.
b. If gene frequencies are **p** = 0.913 and **q** = 0.087 estimate genotype frequencies **P, H and Q.**
c. Is this population in equilibrium? Give evidence for your answer.

(15 points)

Q.2 Write short notes on the following:

a) Ex – situ conservation of Germplasm **(5 points)**
b) Applications of the Hardy-Weinberg Law **(5 points)**
c) Strategy in the creation of the experimental population for Biparental population. **(5 points)**
d) Improvement of selection **(5 points)**

Q. 3 (a) Define plant Biotechnology and outline the steps involved in the genetic engineering of crop plants

(b) Explain any four components needed to perform a Polymerase Chain Reaction (PCR)

(c) What are the advantages and disadvantages of using Random Amplified Polymorphic DNA (RAPD) molecular marker system in crop improvement?

(g) State any four (4) ways in which Autopolyploids can be produced in plant breeding

(20 points)

Q4 Describe the types of responses one expects from selection in crop populations. State the underlining genetic reasons for what you would be observing in the type of selection. **(20 points)**

Q. 5 **(a)** Compare and contrast North Carolina Design I and North Carolina Design II. **(10 points)**

(b) Outline the steps in the analysis of data from Triple Test Cross. **(10 points)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULRURAL SCIENCES
2008 ACADEMIC YEAR FIRST SEMESTER EXAMINATIONS

AGE 211: FUNDAMENTALS OF MICRO-ECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

1. (a) All societies must answer three basic questions which make up the economic problem. What are these questions and explain why they constitute a problem? (5marks)

   (b) Explain as clearly as possible what you understand by opportunity cost. (5 marks)

   (c) What is the production possibility frontier? **(5 marks)**

   (d) What is the difference between explicit and implicit costs? **(5 marks)**

2. (a) Assume that the average price of a new car is $7,000 and that 9 million cars are sold at this price each year. If the price elasticity of demand for new cars is 1.5:

   (i) What will be the effect on yearly sales if the average price of a new car declines to $6930? **(5 marks)**

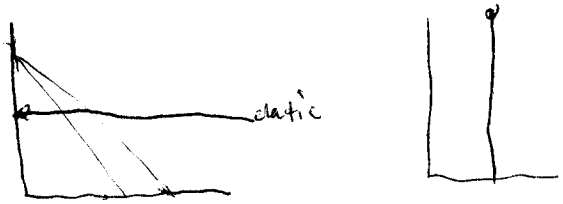
   (ii) Is it a wise decision to reduce the price to $6930? Explain **(5marks)**

   (b) The price elasticity of demand for agricultural products is normally inelastic. Explain why farmers generally succeed financially in years when their productivity is poor. Despite this fact, why do individual farmers strive to produce as much as possible each year? **(10 marks)**

3. (a) " A Giffen good must be an inferior good, but an inferior good need not be a Giffen good." Explain this statement fully using the concepts of income and substitution effect. **(5 marks)**

   (b) Explain the difference between an indifference curve and an isoquant. What are the similarities between the indifference curve and an isoquant. **(5 marks)**

   (c) Explain why indifference curves do not intersect each other. **(5 marks)**



(d) Define an isoquant. What is measured on the axes of a diagram with isoquants? What is the relationship between the isoquant and the Iso-cost line? What is the significance of a tangency between an isoquant and an iso-cost line? **(5 marks)**

4. (a) What is a cartel? Give an example of a cartel. Why do cartels fail? **(7 marks)**

(b) What is price discrimination? Under what type of market structure is price discrimination practiced? Show with the aid of a diagram third degree price discrimination. What conditions are necessary for a firm to practice price discrimination? **(7 marks)**

(c) Explain what you understand by the meaning of mutual interdependence in an oligopolistic market. **(6 marks)**

5. Explain what you understand by the following concepts:

(a) Budget constraint. **(5 marks)**
(b) Transitivity. **(5 marks)**
(c) Change in demand versus change in quantity demanded. **(5 marks)**
(d) Equi-marginal principle. **(5 marks)**

END OF EXAM

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2008 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS
AGE 411: INTRODUCTION TO AGRIBUSINESS MANAGEMENT
TIME: THREE (3) HOURS

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

SECTION A

1. a) List the errors that do not affect the Trial balance and give an example of each.

   b) The Trial balance of Agri-expo as at 31st December 2007 showed a difference which was posted to a suspense account. Draft final accounts for the year ended 31st December 2007 were prepared showing a net profit of $47,240. The following errors were subsequently discovered:
   - Sales of $450 to Intercontinental hotel had been debited to Pamodzi hotel
   - Payment of $ 275 for telephone charges had been entered on the debit side of the telephone account as $375
   - Sales journal had been under cast by $ 2000
   - Repairs to irrigation equipment amounting to $390 had been charged to irrigation equipment account
   - A cheque for $ 1500 for commission received had only been entered in the cash book
   - A purchase from agri-chem amounting to $ 765 was received but the invoice was entered in the Purchases journal

   Required

   i) Give journal entries necessary to correct the above errors **(12 Marks)**

   ii) Show the statement of the corrected net profit as at 31st December 2007**(8 Marks)**

2. Mulenga Ltd manufactures Agricultural equipment and machinery. The company has been given an order to produce 2500 valve castings per month. The fixed costs have been estimated to be K10, 000,000 and the variable costs to be K 15,000 per casting. It is proposed to sell the castings at K 20,000 each.

   Required

   a) i) Determine the break even point for the production of this order**(5 Marks)**

   iii) What level of profit could be made from this order? (**5Marks)**

   b) By investing in a new technology, the scrap rate could be reduced to a reliable level of 2%. However the new technology would increase the fixed costs to K15, 000,000 but reduce the variable costs to K 12,000 per casting. Would this investment be worthwhile in profit terms? **(5 Marks)**

c) Discuss the limitations of break even point analysis **(5 Marks)**

SECTION B

3a. Give a functional definition of management **(2 Marks)**

b.i) Outline Maslow's hierarchy of needs **(5 Marks)**

ii) What is the relevance of Maslow's hierarchy of needs to management? **(5 Marks)**

c i) What are the assumptions of theory X and Y? **(6 Marks)**

ii) Considering the two types of managers in c (i) above which one is more effective and why? **(2 Marks)**

4. A limited company is significantly different from a sole proprietor or partnership in several significant aspects.
Discuss the above statement and highlight the advantages and disadvantages these differences pose to the Agribusiness owner? **(20 Marks)**

5. i) Both preference shares and loan capital are forms of finance that require the agribusiness to provide a particular rate of return to investors. What are the factors that may be taken into account by a business when deciding between these two sources of finance? **(12 Marks)**

ii) The first thing that Agribusiness managers must understand about bank borrowing is that the bank desires to make a profit from the transaction while at the same time reducing the risk of the transaction. Therefore, as required by the lending rules, the banker will apply the three C's of lending before finally approving the loan:

a) Specify the three C's of lending and describe the significance of each**(6 Marks)**

b) What is the role of owner's capital(equity) in bank borrowing**(2 Marks)**

6. i) Discuss some of the unique characteristics of agricultural products and how they impact on operations management and production planning **(6marks)**

ii) Briefly discuss two types of inventory tracking systems used in Agribusiness **(6marks)**

iii) The purchasing activity of selecting suppliers is critical because of the impact of input prices on the agribusiness profits.
Highlight four primary factors that should be considered in selecting a supplier **(8 Marks)**

END OF EXAM

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGE421 PRODUCTION ECONOMICS

TIME: **THREE HOURS**
ANSWER: **ALL QUESTIONS**
MARKS: **100 TOTAL**

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1. Give the following production function of the general form

$$Y = f(X_1/ X_2 \ldots\ldots Xn)$$

And the following prices: Px = K16, Py = K5, TFC = 50

X_1	Y
0	4
1	10
2	18
3	24
4	28
5	30
6	31
7	30

(a) Where does stage III begin? Where does stage II begin? Explain.(4 Marks)
(b) Where does diminishing returns begin? Explain (4 Marks)
(c) What is the most profitable production level? (4 Marks)
(d) What is the maximum net returns possible? (4 Marks)
(e) What is the most profitable level of X_1 and why? (4 Marks)

2. Given the following Quadratic production function.

$$Y_1 = 10x_1 - X_1^2 + 30X_2 - 3X_2^2$$

Prices: P_{X1} = K4, P_{X2} = K7, P_{Y1} = K2, TFC = K80

(a) What combination of inputs will maximize output? (5 Marks)
(b) Derive the expansion path equation. (5 Marks)
(c) What is the most profitable input combination on the expansion path? (5 Marks)
(d) What is the maximum net return at this point (from C above)? (5 Marks)

3. A manager is trying to determine how much of maize and wheat can be produced with difference inputs of Nitrogen (N).

The following are the productions 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.

The manger has 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 = K3.00 per kg.
Pw = wheat price = K2.00 per kg.

(a) How much of N_M and Nw can he use? (4 Marks)
(b) How much M and W will be produced from the levels of nitrogen in (a) (4 Marks)
(c) What happens to the value marginal products when Nitrogen is increased from 100 to 200 kg? (4 Marks)

4. (a) Discuss and illustrate the concept of economic efficiency (in a profit maximizing firm) as it is related to factor-factor relationships. (10 Marks)
(b) Show and discuss the relationship between long-run and short-run cost curves. (8 Marks)
(c) Discuss how long-run equilibrium for a firm is established in a purely competitive market. (8 Marks)

5. (a) Discuss the various ways of combating uncertainty on the farm.(8 Marks)
(b) How do you use a cash flow as a tool for future planning? (6 Marks)
(c) Discuss very briefly the following:
(i) Technical complements (2 Marks)
(ii) Ridgelines (2 Marks)
(iii) Expansion path (2 Marks)
(iv) Equimarginal principle (2 Marks)

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
School of Agricultural Sciences
Department of Agricultural Economics and Extension Education

AGE 531: International Agricultural Markets, Trade and Development
2008 Academic Year, First Semester
Final Exam

Date: 5th December 2008
Duration: 3 hours

Instructions:
1. Place your computer number on each answer book used.
2. Read the questions carefully and answer all.
3. The examination is worth 100 points. Points for each question are indicated in parenthesis.
4. Please be concise in answering the questions and write legibly

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Question 1 (20 points)
Discuss the following concepts:
- **a)** Political Economy and International trade **(5)**
- **b)** Twin Deficit Identity **(5)**
- **c)** Exchange Rate Volatility **(5)**
- **d)** Trade Without Discrimination **(5)**

Question 2 (20 points)
Discuss Trade Diversion in the context of the COMESA Free Trade Area. **(20)**

Question 3 (20 points)
a) Assume that Zambia has 600 units of labour and South Africa has 1,000 units of labour. Both countries produce cloth and wheat. In Zambia, the labour requirement for a metre of cloth is 3 units, while a kilogram of wheat requires 2 units. In South Africa, the labour requirement for a metre of cloth is 5 units, while a kilogram of wheat requires 2 units. In both countries, there are constant costs of production.

i. Draw the production possibilities curves for each country, and calculate the pre-trade price of wheat in each country. **(8)**
ii. When these two countries engage in free trade, which country will export cloth? Why? **(3)**
iii. If either of the two countries implements trade policies, it would be referred to as "protectionism". Why? **(3)**

b) According to the H-O theory, free trade will lead to factor price equalization. In other words, wages will be equalised between rich and poor countries if free trade prevails. However, even with the SADC FTA, there is still a big difference between the wage of South African workers and that of Zambian workers. Why? **(6)**

Question 4 (20 points)

Suppose the supply and demand curves for wheat in Country A are,

$S_w = 10 + 20P_w$ and
$D_w = 100 - 10P_w$

while the supply and demand curves in Country B are,

$S_w^* = 40 + 20P_w$ and
$D_w^* = 80 - 20P_w$

Note that Country A is a "large" country.

a) Graph the import demand curve for Country A and the export supply curve for Country B on the same diagram. **(8)**
b) Calculate the equilibrium free-trade price and the quantity traded ? Show your work. **(3)**
c) Suppose a specific tariff of $0.50 is levied by Country A on the import of wheat from Country B, calculate the new price that would prevail in each country after the tariff is imposed. Explain. **(5)**
d) State whether welfare changes are positive or negative for each of the main economic players in Country A after the implementation of the specific tariff on wheat. **(4)**

Question 5 (20 points)

Use the information in the table below to answer part a) to c). SHOW YOUR WORK.

	Bread Price/loaf	**Exchange Rate 23/10/2008**
Zambia	ZMK 3000.00	--
Botswana	BWP 4.95	550 ZMK/BWP
South Africa	ZAR 6.00	470 ZMK/ZAR

Where ZMK = Zambian Kwacha, BWP = Botswana Pula and ZAR = South African Rand

a. Calculate the ZMK price of bread in Botswana and South Africa as of 23/10/2008. **(4)**
b. Calculate the implied purchasing power parity exchange rates between Botswana and Zambia, and between South Africa and Zambia based on the price of bread. **(4)**
c. Is the ZMK overvalued or undervalued with respect to the BWP and the ZAR in terms of purchases of bread? State why it is over or undervalued. **(6)**
d. Outline and briefly discuss three reasons why the theory of Purchasing Power Parity is considered to be problematic and may not hold in most cases. **(6)**

---- The End ----

The University of Zambia
University First Semester Examinations – December 2008

AGE 431
Linear Programming Applications for Agribusiness

Instructions: Answer one question in Section A; and both questions in Section B. Thus, you are expected to answer a total of three questions in this exam.

Time: Three (3) hours

Section A (40 points)

There are two questions in this section. Answer either one of them.

1. An agribusiness company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B. At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecast to be 40 hours and on machine B is forecast to be 35 hours. The demand for X in the current week is forecast to be 75 units and for Y is forecast to be 95 units. Company policy is to maximize the combined sum of the units of X and the units of Y in stock at the end of the week.
   a) Formulate algebraically the LP problem for deciding how much of each product to make in the current week,
   b) Solve this linear program graphically,
   c) State the optimal objective function value and optimal levels of X and Y, and
   d) Write out syntax for solving this problem in GAMS.

2. An agribusiness firm manufactures two products A and B whose profit per unit sold is US $3 and $5, respectively. Each product has to be assembled on a particular machine; each unit of product A taking 12 minutes of assembly time and each unit of product B taking 25 minutes of assembly time. The company estimates that the machine used for assembly has an effective working week of only 30 hours (due to maintenance/breakdown). The technological constraints mean that for every five units of product A produced at least two units of product B must be produced.
   a) Formulate the algebraic LP problem to determine quantity of each product to produce.
   b) Solve this LP problem graphically
   c) The company has been offered the chance to hire an extra machine, thereby doubling the effective assembly time available. What is the *maximum* amount you would be prepared to pay (per week) for the hire of this machine and why?
   d) Write out syntax for solving this problem in GAMS.

Section B (60 points)

There are two questions in this section. Answer both.

3. Suppose you have the following facts and would like to determine the least cost shipment pattern for wheat.

	Transportation cost ($/tonne)			Excess supply (tonnes)
Surplus provinces	Eastern	Lusaka	Southern	
Central	50	70	90	800
Luapula	70	50	60	600
Northern	60	80	120	200
Excess demand (tonnes)	100	400	500	
Selling price ($/tonne)	80	90	100	

a) Write out the algebraic LP model that you would use to determine the profit maximizing shipment plan.
b) How many (i) real activities and (ii) constraints does this model have?
c) Write out the GAMS syntax that you would use to solve the problem.
d) Assuming fixed charges of $300, $250 and $350 at Central, Luapula and Northern provinces, respectively, write out the corresponding plant location model i) algebraically, and ii) as a GAMS program.

4. Mr. Mbuiwamwambwa is a medium-scale farmer in Nangweshi, Senanga West. He is considering growing paprika and/or cotton. Paprika returns K400,000 per acre while cotton returns K200,000 per acre. He has 240 hours of family labour and 40 acres of land. He also 8,400 kg of fertilizer. Cotton requires 8 hours of labour and 150 kg of fertilizer per acre. An acre of paprika requires 10 hours of labour and 400 kg of fertilizer.
   a) Use the simplex method to solve the problem
   b) State the optimal objective function value and the optimal levels of all real and slack activities
   c) Write out the GAMS syntax that you would use to solve this problem
   d) Set up the dual problem algebraically
   e) Mr. Mbuiwamwambwa's son, who lives in Chunda Ponde, Mpika, has just sent him some money. Should he hire additional labour if each hour costs K12,000? Explain.

----------**END OF EXAM**----------

Happy holidays!

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS NOVEMBER 2008

AGE 511
AGRICULTURAL ORGANIZATION AND ADMINISTRATION

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

TIME: 3 HOURS **DATE: 24th NOVEMBER 2008**

(a) Explain and elaborate what management is. Clearly identify and define the five (5) major management functions? Cite one appropriate example of a specific activity related to performing each of the functions you have identified.

(b) Explain and elaborate the major features of a bureaucratic organization as advanced or articulated by Max Weber?

Explain what strategic planning is elaborating on why is it important in management. Using relevant examples, clearly describe the elements or steps that are followed in a strategic planning process in a typical organization.

Agromark Corporation Ltd is a large agribusiness firm in Zambia involved in the processing and marketing of a wide range of agricultural products such as milk and dairy products; beef and processed meat products; vegetable and fruit products. The corporation has large state of the art processing laboratories and plants where these products are produced. The organizational structure of Agromark Corporation is a matrix structure. Draw an illustration showing the organizational structure of Agromark Corporation. Describe the matrix organizational structure and clearly outline the advantages and disadvantages associated with this type of organizational structure.

(a) Explain and elaborate (i) Herzberg's two-factor theory of motivation, and (ii) Maslow's theory of human needs.

(b) Discuss the similarities and differences between Herzberg's two-factor theory of motivation and Maslow's theory of human needs.

Explain and elaborate what (i) Human Resource Planning and, (ii) Orientation is. Discuss what is involved in these activities and their relevance in terms of the staffing function.

6. Write brief notes explaining salient aspects of the following:

(b) Technical and Conceptual Skills
(c) Unity of Command
(d) Delegation
(e) Line and Staff Authority
(f) Theory X and Theory Y
(g) Functional Departmentation
(h) Communication Process
(i) Employee Assistance Programmes (EAP)
(j) Bases of Leadership Power
(k) Performance Appraisal

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGE 521: INTRODUCTION TO FARM MANAGEMENT

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

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

b) Explain at least four characteristics of Agriculture that makes managing a farm different from managing other businesses. **(16 marks)**

c) Why is goal setting important in a farm business? **(2 marks)**

Q2. Suppose you produced beef using maize and soybeans in a feed ration. You notice on the futures market that maize is going for K1800 per kg while soybeans is going for K3,500 per kg. Furthermore, from past information you know that given the following different combinations of maize and soybeans, you can get 100 kgs of weight gain: (Use the following information to answer a & b)

Combination	Soybeans (kgs)	Maize (kgs)
1	9	127.3
2	13.6	106.8
3	18.2	90.9
4	22.7	79.5
5	27.3	72.7
6	32.6	64.3

a) Calculate the marginal rate of technical substitution and the input price ratio for each combination of the feed ration. **(12 marks)**

b) What is the optimal combination of maize and soybeans in beef production? **(2 marks)**

c) What would be the least cost combination of two inputs X and Y when an isoquant has :
   i) A constant rate of substitution between two inputs and the substitution ratio is not equal to the price ratio? **(3 marks)**
   ii) A constant rate of substitution between two inputs with the substitution ratio equal to the price ratio? **(3 marks)**

Q3 a) List four (4) ways that the equity of a farm business could increase over time. **(4 marks)**

b) A farm business has a current ratio of 2.2 to 1, from K5, 730,100 in current assets.[Ans

i ii, and iii. independently, i.e. answer each with respect to this initial statement]

i) What is value of current liabilities? **(4 marks)**

ii) The firm pays K670, 500 of accounts payable with cash. What is the impact on current ratio? Give the ratio **(4 marks)**

iii) The firm collects K330, 000 of accounts receivable. What is the impact on the current ratio? Give the ratio **(4 marks)**

iv) The firm sells a machine for K800, 000; it has a book value of K900, 000. What is the impact on the current ratio? Give the ratio **(4 marks)**

Q4. a) An enterprise budget shows a yield of 500 kg of cotton per hectare, a selling price of K6,000 per kg and a total cost of K2,500,000 per hectare. Estimate the cost of production, break-even yield and price **(6 marks)**

b) Mr. Muyunda sells weaner steers at 205 kg for K8500 per kg. He is considering holding the steers and fatten them for 120 days to gain a feeder weight of 295kg during which he can sell them at K8000/kg. Variable costs associated with weaners amounts to K406,000, while feeder weight costs include K140,000 interest, miscellaneous cost of K135,000 and K2000 cost per kg of weight gained.

i) Describe the proposed change **(2 marks)**

ii) Prepare a partial budget for the proposed change and give advice to Mr. Muyu **(8 marks)**

iii) What is the value of added returns in the plan? **(2 marks)**

iv) What is the value of reduced costs? **(2 marks)**

Q5. a) What are technical coefficients used for in whole farm planning? **(2 Marks)**

b) Explain the difference between whole farm budget and an enterprise budget. **(2 marks**

c) List the methods used in making capital budgeting decisions. **(4 marks)**

d) Suppose an entomologist estimates that there is a 30% chance of a major in infestation that could reduce per ha gross margin by K240,000. If no infestation occ you expect to receive a gross margin of K480,000 per ha. Treatment for insect is effec but costs K60,000/ha.

i) Show the possible results of treating or not treating in a decision tree. **(8 marks)**

ii) What is the expected gross margin for each outcome? **(4 marks)**

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2008 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

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1. a) Sometimes agricultural project analyses prove wrong because of project design and implementation. Briefly explain three problems that have been shown to be related to project design and implementation. (9 marks)

b) Describe and illustrate by use of diagrams the "With" and "Without" project comparisons obtaining in three different scenarios. (9 marks)

c) What is the difference between the "before" and "after" comparison as opposed to the "with" and "without" project comparison? (2 marks)

2. a) Although the process of project analysis is highly iterative, there are, in general, steps that an analyst has to follow. Outline the main steps that should be followed in project analysis. (8 marks)

b) What are the main limitations of project format? (6 marks)

c) Describe the main steps that should be followed in converting financial prices to economic values. (6 marks)

3. It is proposed to invest a total of K1.5billion in a coffee project. The following streams of investment outlay, operation and maintenance costs (cash outflows) as well as gross benefits (cash inflows) are projected:

Amounts in K'million				
Year	**Investment Outlay**	**Operation and maintenance**	**Production Cost**	**Gross Benefit**
1	350	0	0	0
2	300	0	0	0
3	300	0	0	0
4	300	0	0	0
5	250	0	0	0
6	0	40	40	680
7	0	40	50	790
8	0	40	60	900
9	0	40	70	910
10	0	40	80	920

a) Compute the Net Benefit-Investment (N/K) ratio if the opportunity cost of capital is 15%. On the basis of the N/K you obtain, would you recommend the project as good investment? Explain why? (6 marks)
b) Compute the Internal Rate of Return (IRR). On the basis of the IRR you obtain and given 15% as the opportunity cost of capital, would you recommend the project as good investment? Explain why? (10 marks)
c) Explain what is meant by the assertion that "projects are the cutting edge of development". (4 marks)

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

	Foreign Exchange Component (US$'000)			Domestic Currency Component (K'million)	
Year	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	0	300	0	300	0
2	0	250	0	250	0
3	0	250	0	200	0
4	350	0	150	150	150
5	500	0	250	0	200
6	650	0	300	0	200
7	700	0	400	0	200
8	800	0	400	0	200
9	800	0	400	0	200
10	680	0	400	0	200

a) If the opportunity cost of capital is 15%, compute the domestic resource cost (DRC). If the official exchange rate (OER) is K4, 500 to US$1 and on the basis of the DRC you obtain, is the project favourable? Explain why? (10 marks)
b) If there is a foreign exchange premium of 20%, what is the shadow exchange rate (SER)? In the light of the SER you obtain and on the basis of the DRC you obtained in a) above, would you say the project is favourable? Explain why? (5 marks)
c) Why is it important to determine the DRC and for what type of projects? (5 marks)

5. Write short notes on the following giving formulas and/or examples where appropriate:
   a) Marginal Value Product in Project Analysis. (5marks)
   b) Sensitivity Analysis in Project Analysis (5. marks)
   c) Depreciation in Economic Analysis. (5 marks)
   d) Secondary costs and benefits. (5 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2008 ACADEMIC YEAR FIRST SEMESTER

FINAL EXAMINATIONS

AGF 211: GENERAL MICROBIOLOGY

PRACTICAL PAPER

DURATION: THREE (3) HOURS

INSTRUCTIONS: Answer **ALL** Questions

Question One (1)

a) List the principal parts of the Light Microscope **(10 Points)**

b) Which objective focuses closest to the slide? **(2 Points)**

c) Describe how you would determine the total magnification of the object when using a Light Microscope **(2 Points)**

d) Define resolving power (or resolution) and name two ways in which you can enhance the resolving power **(4 Points)**

e) Give two advantages of staining bacteria before examining under the light microscope **(2 Points)**

Question Two (2)

a) **PERFORM** a Gram stain on specimen **A** and **B**, and explain the steps of the Gram staining technique **(8 Points)**

b) Sketch a few bacteria; give magnification, morphology and arrangement, colour and Gram's reaction **(6 Points)**

c) Explain what would happen if human cells were stained **(2 Points)**

d) Explain why the Gram stain is said to be a differential stain **(2 Points)**

e) Give two conditions that may result in a gram positive organism staining gram negative **(2 Points)**

Question Three (3)

a) Define the following terms

i. Aseptic technique **(2 Points)**

ii. Colony **(2 Points)**

b) Briefly describe the pour plate method and how it is used to determine the number of bacteria **(6 Point)**

c) From the information provided in the table below, calculate the number of colony forming units per ml. show your calculation **(4 Points)**

Dilution	Number of colonies
10^{-2}	230
10^{-2}	220
10^{-3}	60
10^{-3}	55
10^{-4}	8
10^{-4}	6

d) What is the purpose of serial dilutions in the enumeration of microorganisms **(2 Points)**

e) Could some bacteria grow on the streak plate and not be seen on the pour plate technique? Explain **(4 Points)**

Question Four (4)

a) Classify microorganisms on the basis of temperature range at which growth occurs **(8 Points)**

b) Compare the effectiveness of moist heat and dry heat and describe how both moist heat and dry heat destroy microorganisms **(4 Points)**

c) State two methods of applying moist heat and two methods of applying dry heat **(2 Points)**

d) Define osmotic pressure **(2 Points)**

e) Describe how bacterial growth is inhibited in jams and salted meats **(4 Points)**

Question Five (5)

1.

a) Define the following terms

   i. Sterilization **(1 Point)**

   ii. Disinfection **(1 Point)**

b) Identify four (4) factors that may influence antimicrobial activity **(4 Points)**

c) Describe two mechanism of action of disinfectants (i.e. how they harm the microorganism) **(2 Points)**

d) Name one commonly use disinfectant and one commonly used antiseptic in most house holds **(2 Points)**

2.

a) Interpret the results in specimen **C** **(3 Points)**

b) Interpret the results in specimen **D** **(3 Points)**

c) Name the general products that may be formed as a result of bacterial fermentation of sugars **(2 Points)**

d) Describe how the above end products change the appearance of the Broth tube, Durham tube and pH indicator (Methyl Red) **(2 Points)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2008/09 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS PRACTICAL

TIME ALLOWED: THREE HOURS

INSTRUCTIONS

1 There are two practical questions in this examination paper.

2 Answer both questions by carry out the required procedures

3 You are advised to start with question one as it requires at least two hours to develop

4 Marks are shown in squared brackets.

---

1 A client suspects a food sample to contain proteins and consequently hydrolyzes the sample. The hydrolyzed sample, **S 01**, is then brought to your food laboratory for analysis.

(a) Design a procedure on how you would proceed using a named and suitable chromatographic technique (4marks)

(b) Carry out the analysis and identify the component(s) in the food sample (7marks)

(c) Write a report to the company. [4marks]

2 A food processing company has brought one food sample to your food laboratory for titratable acid determination. The sample is labeled **S 02**.

Carry out the determination and express the acidity of the sample as percent (w/v) tartaric acid, $C_2H_4O_2(COOH)$ (MM = 150.09275). (15marks)

Note: You are advised to carry out at least three titrations each for the standardization of alkali and food sample.

You need to weigh individual 0.7 to 0.8g samples of potassium hydrogen phthalate (KHP) for standardization of sodium hydroxide.
MM for KHP = 204.2212.

END OF PRACTICAL EXAMINATION

THE UNIVERSITY OF ZAMBIA

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2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 321 – Food Chemistry Practical

Instructions:

This paper has a total of **six (6)** questions and you are required to answer a total of **five (5)** questions
Answer **Question one (1) (Compulsory)** and **any other four (4)** questions of your choice.
All questions carry 20 points

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

Section I

1. Crude protein in foods is determined by various laboratory methods. One of the famous methods is known as the kjeldahl method.

(a) Mention three reagents at the digestion stage and explain their purpose at that stage **(6 marks)**

(b) If after digesting a sample for a long time, there is no relevant colour change, suggest possible things that could have gone wrong **(2 marks)**

(c) What is the purpose of the distillation stage in the crude protein determination (explain mentioning all the relevant reagents and their purpose at this stage) **(5 marks)**

(d) What is the importance of titration stage, and why is it necessary to standardize the acid for titration at this stage? **(4 marks)**

(e) Mention any other method apart from kjeldahl method for determining protein in foods and give a brief principle of that method **(3 marks)**

Section II (Choose any four questions from this section)

2. Imagine you are just appointed a food laboratory manager in a food company. The company has no laboratory. The company intends to set a laboratory for the quality control of their food products. As a food laboratory manager, write a report suggesting what the company needs in order to begin testing for the following food

properties. In your report also include why they may need what you would be suggesting in your report.

(i) Fat content **(5 marks)**

(ii) Ash **(5 marks)**

(iii) Outline the different types of fat and state limitations in determining those types of fat in the method you are suggesting in your report **(4 marks)**

(iv) What is meant by ash? **(2 marks)**

(v) Ash determination is also a preliminary stage in determination of another set of quality properties. Mention this set of quality properties **(1 mark)**

(vi) State some precautions you would take during ashing to ensure quantitative determination of that set of quality properties **(3 marks)**

3. Imagine you are running a food laboratory. A client who produces fatty foods brings a sample to you and claims that his/her customers are complaining that the food has a rancid odor.

(i) What quality properties (5 relevant properties) would you recommend to determine in your laboratory in order to show that rancidity is responsible for the customer's complaints **(5 marks)**

(ii) Choose any two of the properties in (a) and explain how you would determine them in your laboratory? **(15 marks)**

4. There are various methods for moisture determination. Mention any two such methods and explain how each method works in order to determine moisture content. **(20 marks, 10 marks for each method)**

5. What do you understand by the following terms and what is their importance in the laboratory:

(a) Colorimetric methods **(4 marks)**

(b) Ion exchange chromatography **(4 marks)**

(c) Free and bound lipids **(4 marks)**

(d) Reducing sugars **(4 marks)**

(e) Iodine value **(4 marks)**

7.

(a) Explain how you would determine crude fiber in the laboratory in a given food sample (explain the purpose of every stage you mention) **(15 marks)**

(b) What is the difference between crude fiber and dietary fiber? **(5 marks)**

.....End of Exam.....

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 341 – Technical Thermodynamics

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

Marks allocated for each question are indicated at the end the questions

Useful formula and constants are listed on the last page

Time allowed: Three (3) Hours

Q.1 A refrigerator uses refrigerant-134a as a working fluid and operates on an ideal vapour-compression refrigeration cycle between 0.14 and 0.8MPa. If the mass flow rate of the refrigerant is 0.05kg/s, determine

a. the rate of heat removal from the refrigerated space **[3]**
b. the power input to the compressor **[3]**
c. the rate of heat rejection to the environment **[3]**
d. the COP of the refrigerator **[1]**

Suppose the throttling valve is replaced by an isentropic turbine, determine

e. the power produced by the turbine **[3]**
f. the power input to the refrigerator **[2]**
g. the rate of heat removal from the refrigerated space **[3]**
h. the COP of the refrigerator **[2]**

Q.2

a. A 20-kg aluminium block (C = 0,98kJ/(kg K) initially at 200°C is brought into contact with a 20kg block of iron (C = 0,45kJ/kg_K) at 100°C in an insulated enclosure. Determine:
   i. the final temperature, **[6]**
   ii. the entropy change for this process. **[4]**

b. A Carnot heat engine operates between a source at 720°C and a sink at 25°C. If the heat engine is supplied with heat at a rate of 800kJ/min. Determine :
   i. the thermal efficiency **[5]**
   ii. the power output of this heat engine **[5]**

Q.3

a. A household refrigerator that has a power input of 450W and a COP of 2.5 is to cool five large watermelons, 10kg each, to 8°C. If the watermelons are initially at 20°C and have a specific heat of 4.2 kJ/kg. °C. Determine:
   i. how long it will take for the refrigerator to cool them **[5]**
   ii. explain whether your answer is realistic or optimistic **[3]**

b. A piston-cylinder device initially contains air at 150kPa and 27°C. At this state, the piston is resting on a pair of stops, and the enclosed volume is 350 litres. The mass of the piston is such that a 350 kPa pressure is required to move it. The air is now heated until its volume has tripled. Determine

i. the final temperature **[4]**
ii. the work done by the air **[4]**
iii. the total heat transferred to the air **[4]**

Q.4

a. Discuss the physical significance of entropy in a system and explain its relationship with work. **[10]**

b. Steam at 3Mpa and 400°C enters an adiabatic nozzle steadily with a velocity of 40m/s and leaves at 2,5Mpa and 300m/s. Determine:

i. the exit temperature. **[5]**
ii. the ratio of the inlet to exit area A_1/A_2 **[5]**

Q.5

a. Explain the factors that should be considered when selecting a refrigerant. **[7]**

b. Explain and illustrate the Cascade Refrigeration System and its application in the food industry. **[7]**

c. Your roommate opens the door of their refrigerator on a hot October day in order to cool the room. As thermodynamics student, is this goal attainable and what is effect of this action on the refrigerator components. **[5]**

Q.6

a. Explain and illustrate the Carnot cycle. **[12]**

b. State the law that governs this cycle and give an example of its application in the food industry. **[8]**

Data

$Q=\Delta U+W$

$COP_{HP} = Q_H / (Q_H - Q_L)$

$COP_{HP} = Q_H/W$

$COP_R = Q_L/W$

$\eta_{th} = W/Q_H$

$\Delta H= mc_p\Delta T$

$V=4/3\pi r^3$

$m= \rho vA$

$\theta = h +v^2/2 +gz$

$Q_{in}+W_{in} + \Sigma m_i \theta_i= Q_{out} +W_{out} + \Sigma m_e\theta_e$

$s= s_f +xs_{fg}$

$\Delta S_{syst} = Q/T_{sys}$

$W = m(h_1-h_2)$

$P_1V_1/T_1=P_2V_2/T_2$

$\Delta s= mc_v \ln(T_2 / T_1)$

$\Delta s = mc_p \ln(T_2 / T_1)$

THE UNIVERSITY OF ZAMBIA
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DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2008 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGF 411: UNIT OPERATIONS IN FOOD ENGINEERING 1

TIME: THREE HOURS

INSTRUCTIONS:

1. Please read the instructions and each question carefully.
2. Answer **ALL** questions.
3. **ALL** questions carry equal marks.
4. Useful formulas are provided on the last page.

****

1. In the process of producing concentrated juice, a fresh extracted and strained juice containing 10 wt % solids is evaporated in the first evaporator, giving 18 wt % solids in the juice. This is fed to a second evaporator, which gives 50 wt % concentrated juice as a final product.
   a) Draw and clearly label the process flow diagram **(6 points)**
   b) Calculate the water removal from each evaporator **(6points)**
   c) Calculate the amount of product produced (concentrated juice) **(6 points)**
   d) What does the law of conservation of mass state? Is it holding in the above process? Show by performing a check either on a component or on the overall process. **(7 points)**

2. Water with density of 998 Kg/m^3 is flowing at a steady mass flow rate through a uniform-diameter pipe. The entrance pressure of the fluid is 68.9 KN/m^2 in the pipe, which connects to a pump which supplies mechanic energy of 155.4 J/Kg of the fluid flowing in the pipe. The exit pipe from the pump is the same diameter as the inlet

pipe. The exit section of the pipe is 3.05 m higher than the entrance, and the exit pressure is 137.8 KN/m^2.

a) Calculate the frictional loss in the pipe **(10 points)**

b) Differentiate between absolute pressure and gauge pressure. **(5 points)**

c) Reynolds number is very important in determining the flow type in fluid flow. This number has dimensions. YES or NO, elaborate. **(7 points)**

d) Define viscosity and give one reason why it is important in fluid flow. **(3 points)**

3. A retort containing 1000 cans of apple sauce was sterilized at 121°C. After sterilization the cans need to be cooled down to 37°C before leaving the retort. The specific heat of the apple sauce and the can metal are 3730 and 510 J/Kg K, respectively. Each can weighs 50g and contains 450g of apple sauce. The retort wall is made of cast iron with specific heat of 450 J/Kg K and weighs 3000 Kg. It is assumed that cooling by surrounding air is negligible. Taking the specific heat of water to be 4180 J/Kg K,

a) Calculate:

I. The amount of cooling water required if it enters at 20 °C and leaves at 30 °C. Show all steps **(10 points)**

II. Generally, give five aims of food processing. **(5 points)**

III. The law of conservation of energy states that energy can neither be created nor destroyed. Elaborate this law referring to what is happening to the cans. **(5 points)**

b) ***Hurdle Technology*** is nowadays used in food preservation in order to reduce undesirable changes of processed foods. What is ***Hurdle Technology***? In your explanation, cite examples. **(5 points)**

4. a) You have a plug flow reactor with a volume of $5m^3$. The reaction $A + B \rightarrow C$ is of first order in A with a kinetic constant K of $3 * 10^{-4}/s$. The feed stream contains 2 $kmoles/m^3$ of A and $R_A = dC_A/dt = -K_A.C_A$. If the feed stream $F_{A0} = 5.56mol/s$, what conversion will be reached and what concentration of A will be left in the exit stream? **(12 points)**

b) Plug flow and CSTR reactors are commonly used in the brewing industry. Describe each of them and state their advantages and disadvantages. **(7 points)**

c) Sketch and label the plan of shear stress vs shear rate for Newtonian, Pseudoplastic and Dilatant fluids. Give an example of one product in each category. **(6 points)**

END OF EXAMINATION

FORMULA LIST

$F = mg = V\rho g$

$P = F/A = P_s + Z\rho g$

$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

$A_1 v_1 = A_2 v_2$

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

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

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

$E_f = \Delta P_f/\rho = (2fv^2)(L/D)$

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

$\Delta P_f = (4f\rho v^2/2) \times (L/D)$

$F/A = \mu v/Z = \mu (dv/dz) = \tau$

$\rho v^2 D/\mu v = Dv\rho/\mu$

$P = Z \rho g$

$P_1 - P_2 = (4f\rho v^2/2)(L_1 - L_2)/D$

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

$$t_r = n_{A0} \int_0^{X_{Af}} \frac{dX_A}{R_A V_b}$$

$$\frac{V}{F_A} = \int_0^{X_{Af}} \frac{dX_A}{R_A}$$

$$\frac{d}{dt}[n_{A0}(1 - X_A)] = -n_{A0} \frac{dX_A}{dt}$$

$$-R_A V_b = -n_{A0} \frac{dX_A}{dt}$$

THE UNIVERSITY OF ZAMBIA
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DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

2008 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGF 431: FUNDAMENTALS OF BIOCHEMICAL ENGINEERING

TIME: THREE HOURS

INSTRUCTIONS:

1. Please read the instructions and each question carefully.
2. Answer **ALL** questions.
3. **ALL** questions carry equal marks.
4. Useful formulas are provided on the last page.

****

1. A continuous fermenter is operated at a series of dilution rates but at constant sterile feed concentration, pH, aeration rate and temperature. The data given below were obtained when the limiting substrate concentration was 1200 mg/litre and the working volume was 9.8 litres. The microbial system follows a modified Monod kinetic model described by the following equation:

$$\mu = \frac{\mu_{max} C_S}{K_S + C_S} - k_e$$

Feed flowrate (L/h)	Exit substrate concentration (mg/L)	Dry weight cell density (mg/L)
0.79	36.9	487
1.03	49.1	490
1.31	64.4	489
1.78	93.4	482
2.39	138.8	466
2.68	164.2	465

a) Estimate:

I. The kinetic constants K_S, μ_{max}, and K_e as used in the modified Monod **(9 points)**

II. The growth yield coefficient Y **(3.5 points)**

b) Mention four factors that affect the specific growth rate of the microbial culture? **(4 points)**

c) Using the batch culture experiments, describe briefly how you can estimate the Monod kinetic parameters K_S, and μ_{max}, **(5 points)**

d) Differentiate between structured and unstructured models as used in cell kinetics **(3.5 points)**

2. a) Stirred tank, Bubble column and Air – lift are some of the fermenter configurations used in cell cultivation. For each, give three advantages and three disadvantages **(10 points)**

b) Vinegar is one of the products produced using Biochemical engineering techniques. Describe two routes by which it is produced **(5 points)**

c) Describe three method used in physical immobilization of enzymes **(6 points)**

d) Starter culture is one of the products produced by biochemical engineering processes and it is such a wonder to the food industry. Justify the statement **(4 points)**

3. I) a) Derive the michaelis menten rate equation, giving all the assumptions made **(10 points)**

b) How do enzyme reactions differ from chemical reactions **(3 points)**

c) What commercial applications employ enzymes **(2 points)**

II) Suppose that glucose can be converted to glucose-6-phosphate by certain amount of hexokinase at the following rates

Glucose Concentration(mM)	mM Glucose converted per minute
1×10^{-5}	0.15
2×10^{-5}	0.25
1×10^{-4}	0.60
3×10^{-4}	0.77
5×10^{-4}	0.81

Plot these points, indicating the units for reaction velocity and substrate concentration. **(2 points)**

a) Does the shape of this curve suggest that the reaction will reach a maximal rate? By inspection of the curve, estimate the maximal rate, including units. **(4 points)**

b) Draw a horizontal line on the graph to indicate your estimate for the maximal rate of this reaction (Vmax). **(2 points)**

c) Using your estimated Vmax, indicate **on the graph** how you would estimate the Km value for this hexokinase. Record your estimate, including units. **(2 points).**

4. I) a) What is an enzyme? **(2 points)**

b) How are enzymes classified by the international enzyme commission **(4 points)**

c) What is the line-weaver burk plot in enzyme kinetics **(3 points)**

d) How can the Michaelis-Menten equation be used to obtain the change of substrate concentration with respect to time in a batch reactor **(4 points)**

II) (a) Lysozyme is an enzyme that breaks down bacterial cell walls. Its Km is 6 mM. Chymotrypsin is a digestive enzyme that breaks peptide bonds, and its Km is 5000 mM.

i) Which of these two enzymes has the higher affinity for its substrate? **(2 points)**

ii) Which enzyme(s) [lysozyme only, chymotrypsin only, both or neither] will be operating at maximum efficiency at the following concentrations of substrate:

a) 1 mM
b) 100 mM
c) 6 mM
d) 5000 mM
e) 50,000 mM

(10 points)

FORMULA LIST

$$_2 = \frac{\mu_{\max} C_{S_2}}{K_S + C_{S_2}} \frac{(C_{S_0} - C_{S_2})}{\left(\frac{D_1 K_S}{\mu_{\max} - D_1} - C_{S_2} \right)}$$

$$\frac{\mu_{\max} C_S}{K_S + C_S} = YD \frac{(C_{S_0} - C_S)}{C_X}$$

$$_{X_1} + \mu_2 V_2 C_{X_2} - F C_{X_2} = \frac{dC_{X_2}}{dt} V_2$$

$$_{X_1} = Y \left\{ C_{S_0} - \frac{D_1 K_S}{\mu_{\max} - D_1} \right\}$$

$$\frac{C_X}{C_{S_0} - C_S)} = \frac{K_S Y}{\mu_{\max}} \frac{1}{C_S} + \frac{Y}{\mu_{\max}}$$

$$\mu_{\max} \left(\frac{C_S}{K_S + C_S} \right) \left(\frac{K_P}{K_P + C_P} \right)$$

$$\frac{C_X}{\tau_m} = r_X = \frac{\mu_{\max} C_S C_X}{K_S + C_S}$$

$$\mu = \frac{\mu_{\max} C_S}{K_S + C_S}$$

$$\mu = \frac{\mu_{\max} C_S}{K_S + C_S} - k_e$$

$$C_{S_1} = \frac{D_1 K_S}{\mu_{\max} - D_1}$$

$$D_2 = \frac{F}{V_2} = \frac{r_{X_2}}{C_{X_2} - C_{X_1}}$$

$$(\mu_{\max} - D_2) C_{S_2}{}^2 + \left\{ \frac{D_1 D_2 K_S}{\mu_{\max} - D_1} - D_2 K_S - \mu_{\max} C_{S_0} \right\} C_{S_2}{}^2 + \frac{D_1 D_2 K_S{}^2}{(\mu_{\max} - D_1} =$$

$$D_2 = \frac{\mu_{\max} C_{S_2}}{K_S + C_{S_2}} \frac{C_{X_2}}{C_{X_2} - C_{X_1}}$$

$$C_S = \frac{K_S}{\tau_m \mu_{\max} - 1}$$

$$\frac{C_{S_0} - C_S}{C_X} = \frac{K_e}{YD} + \frac{1}{Y}$$

$$D(C_{S_0} - C_S) = \frac{\mu_{\max} C_S C_X}{Y(K_S + C_S}$$

$$\tau_m = \frac{1}{\mu} = \frac{1}{D}$$

$$\frac{1}{\mu} = \frac{K_S}{\mu_{\max}} \frac{1}{C_S} + \frac{1}{\mu_{\max}}$$

$$Y_{X/S} = \frac{\Delta C_X}{-\Delta C_S} = \frac{C_X - C_{XO}}{-(C_S - C_{SO})}$$

$$\mu = \mu_{\max} \left(\frac{C_S}{K_S + C_S} \right) \left(1 - \frac{C_P}{C_{Pm}} \right)^n$$

$$\frac{C_X}{\tau_m} = r_X = \frac{\mu_{\max} C_S C_X}{K_S + C_S}$$

$$\alpha = \sqrt{\frac{K_S + C_{S_i}}{K_S}}$$

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

2008 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS

AGF 441: WATER AND FOODWASTE TREATMENT

INSTRUCTIONS:

1. Please read the instructions and each question carefully.
2. Answer **ALL** questions.
3. **ALL** questions carry 25 Points
4. Duration of the Examination **3** hours

****

1. The food industry is one of the largest water users and generates large volumes of wastewaters which require treatment. For each of the following sectors, outline briefly the problems associated with the wastewaters generated. Suggest in brief possible treatment options of the wastewaters from each.
    a) Dairy processing sector **(5 points)**
    b) Distillery and Fermentation processing sector **(5 points)**
    c) Confectionary/Soft drinks processing sector **(5 points)**
    d) Meat processing sector **(5 points)**
    e) Starch processing sector **(5 points)**

2. The activated-sludge system is the most versatile of the biological treatment systems and forms a very critical step as a secondary treatment in wastewaters.
    a) Define activated sludge **(2 points)**
    b) Outline three problems (floc formation defects) affecting sludge in wastewater treatment. **(3 points)**
    c) How can each of the problems mentioned in **(b)** be minimized? **(5 points)**

d) Name three types of specialized sludge systems and give two advantages for each system. **(6 points)**

e) Name three recovery products of activated sludge and give their economic significance. **(5 points)**

f) Mention two basic methods of aeration used in activated sludge system **(4 points)**

3. (a) Potable water is important both for industrial and domestic application why? Describe in detail with a flow diagram the water treatment and transmission process from the Kafue river intake up Stuart Park **(20 Points)**.

(b) Name the industrial contaminants or emitions associated with each of the following **(5 points)**

(i) Food industry

(ii) Rubber industry

(iii) Cement industry

(iv) Textile industry

(v) Petroleum industry

4. In waste water treatment describe what is involved in the following stages

a) Facultative ponds **(10 Points)**

b) Preliminary treatment to trickling filters stage **(10 Points)**

c) How would you describe the ecology of waste water stabilization ponds **(5 Points)**

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2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 511 – Unit Operations in 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.**

All questions carry equal marks and marks are indicated at the end of each question

Time allowed: Three (3) Hours

SECTION 1

1. A mixture of 450kmol per hour of 60 mole % of A and 40 mole % of B is to be distilled to get a distillate of 95 mole % A and a residue of 5% A.
   The Feed is preheated so that it enters the column with a molar percentage vapourisation equal to distillate – feed ratio. The reflux ratio for this system is 2.0.

   The following is a list of additional data for the process:

   Boiling Point of A = 78°C

   Boiling Point of B= 102°C

   Relative volatility of A/B = 2.5

   Determine the following:

   a. The amounts of the distillate and bottoms **(5 marks)**
   b. The minimum reflux ratio **(5 marks)**
   c. The number of steps required for this process **(7 marks)**
   d. The overall efficiency of the tower is 60 %. Determine the actual number of trays in this column. **(3 marks)**

2. A feed of sunflower seeds is used for extracting oil and the residual cake is sold to farmers as animal feed. Ten thousand kilograms (10 000kg) of crushed sunflower seeds are charged into a countercurrent extractor per hour. The

sunflower seeds were analysed to have contained 20% oil by proximate analysis and 90% of this oil is to be extracted. The final solution is expected to contain 50% of oil. One kilogram (1kg) of solution is associated with 2kg of inert material. A pure solvent, hexane, is used for extracting the oil.

Find:

a. Amount of solvent used in this unit operation **(4 marks)**
b. Amount of the raffinate and extract removed from the system **(7 marks)**
c. The Composition of the raffinate **(4marks)**
d. The number of stages required in this process **(5 marks)**

3.

a. A batch of filled and sealed steel cans containing 26,280 kg juice are to be cooled from 93°C to 32°C just before labeling. An average empty can weighs 170 grams and the production rate is 300 cans per minute.
The specific heat capacities of the juice and steel are 3.7 kJ/kg °C and 0.46 kJ/kg °C, respectively.
Calculate the following on an hourly basis:
   i. Estimate the energy removed from the cans **(4 marks)**
   ii. Estimate the energy removed from the juice **(2marks)**
   iii. Calculate the total cooling energy required. **(2 marks)**

b. Unit operations may be classified according to the type of throughput, as **batch**, **semi batch** and **continuous** processes.
Define these **three (3)** terms briefly. **(12 marks)**

4. Discuss the concept of Liquid – liquid extraction and the equipment used in this unit operation. Explain the principle by which the equipment perform the operation. Support your answer by way of two diagrams of equipment.
(20marks)

5. Answer the following in five lines or less:

a. Packed towers are versatile in that they are used in at least four unit operations. Name **three (3)** of these unit operations **(3 marks)**
b. Discuss briefly **two (2)** purposes of using packings in towers **(4 marks)**

c. Describe **two (2)** remedies for channeling. **(3 marks)**

d. In distillation, it is advisable not to supply the feed to the reboiler because the system does not produce a pure bottom product.

i. Give and explain the reason why the bottoms product is never pure. **(4 marks)**

ii. Discuss briefly how this limitation is removed. **(6 marks)**

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

1. A single-effect falling film evaporator is used to concentrate 4326 kg/h of a 10% solution of NaOH in water entering at 30 °C to a product of 40% solids. The gauge pressure of the saturated steam used is 71.1 kPa and the pressure in the vapour space of the evaporator is 12.1kPa. The overall heat-transfer coefficient is 1560 $W/m^2.K$. Calculate

   a. the steam used, **(8 marks)**

   b. the steam economy, **(4 marks)**

   c. the heating surface area in m^2 , **(4 marks)**

   d. What changes should be made to the evaporator in order to reduce its size and increase its efficiency. **(4 marks)**

2.

   a. Mongu Mango Juice Company would like to manufacture concentrated juice. As a local food processing expert, describe and illustrate in detail the type of equipment you would advice this company to use. Justify your choice. **(10 marks)**

   b. Explain and illustrate the operation of a parallel-feed multiple-effect evaporator and give an example of the type of product manufactured using this evaporator. **(10 marks)**

3.

   a. Describe the type of crystallizer used in the ice-cream making process. **(8 marks)**

b. A salt solution of 30 wt % Na_2CO_3 is cooled to 293K (20°C). The salt crystallizes as the dehydrate and the solubility is 21.5 kg anhydrous Na_2CO_3/100 kg of total water. If the amount of mother liquor obtained is 7250kg after 5% of the original water is lost by evaporation on cooling. Calculate;

i. the yield of Na_2CO_3. 10 H_2O crystals. **(6 marks)**

ii. the amount of feed solution. **(6 marks)**

Data for the Examination

$F = D + B$

$x_D / R_D + 1$

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

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

$q = 1\text{-}f$

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

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

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

$L_o + V_2 = L_1 + V_1 = M$

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

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

$C_p = 1.675 + 0.025\ w$

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

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

$\lambda = H_s - h_s$

$F = L + V$

$Fx_F = Lx_L$

$q = U\ A\ \Delta T$

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

$q = (H_2 + H_v) - H_1$

molar weight

$MgSO_4 = 120$

$H = 1$

$O = 16$

$K = 39.1$

$Cl = 35.45$

$Na_2CO_3 = 106$

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SCHOOL OF AGRICULTURAL SCIENCES

2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 521 - Principles of Food Technology II

Instructions:

This paper has a total of **Eight (8)** questions and you are required to answer a total of **five (5)** questions
Answer **Question one (1) (Compulsory)** and **any other four (4)** questions of your choice.
All marks allocated to each question are indicated at the end of each question

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

1.

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

b.

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

ii. With the use of Casein as an example, describe how non thermal gelation influences the formation of casein gels (two modes of casein gelation) **(10 marks)**

2. Rouse et al. (1996) studied the surface-active behaviour of ethoxylated alkyl sulphate surfactants at the water/air interface. The general formula of these surfactant is $C_{12}H_{25}(C_2H_4O)_nSO_4Na$, with n = 0,1,2,3 and 4 for SDS, CS-130, CS-230, CS-330 and 4N respectively. The results of capillary rise experiments at 22°C are expressed in volumetric units (µl); the diameter of the capillary was 0.08922 cm. The dilution liquid was distilled water. The graphical results are shown in figure 1.

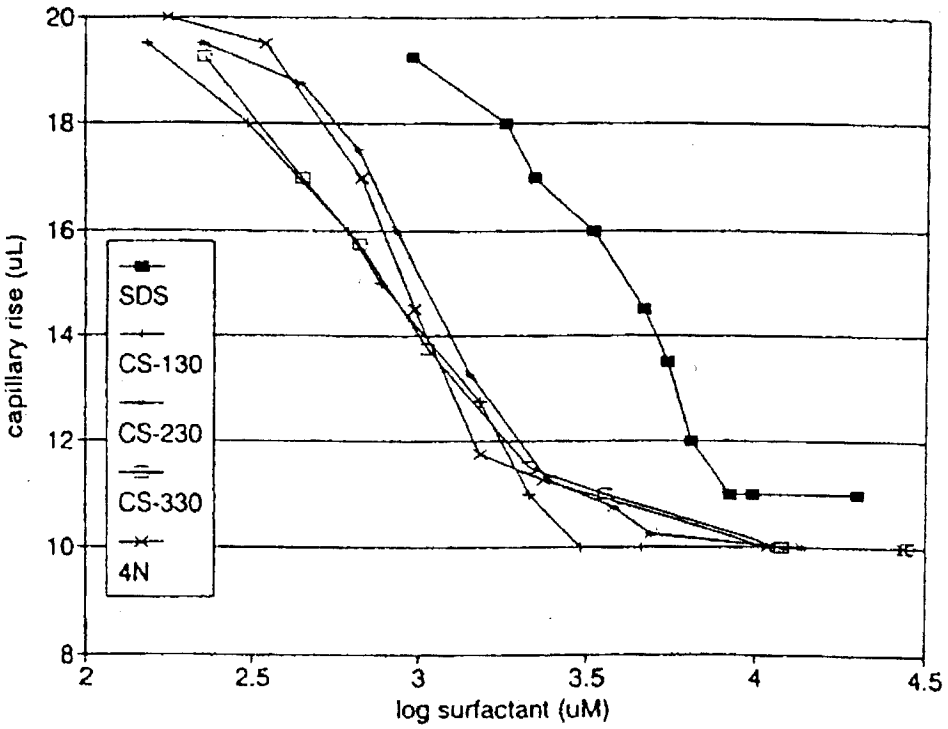

Figure 1: Surface-active behaviour of ethoxylated alkyl sulphate surfactants at the water/air interface (NB: Concentration is in log scale in micro molar)

Using the figure given, answer the following questions:

a. Calculate the limiting surface tension at high surfactant concentrations for SDS. **(10 marks)**

b. Calculate the CMC of SDS **(3 marks)**

c. Explain, in a few lines, the behaviour of the surfactants in the slope region and also in the region where there is stabilization. **(7 marks)**

3.

a. State and explain **two (2)** roles of emulsifiers in the process of emulsification **(5 marks)**

b. Discuss **three (3)** types of flow conditions that are prevalent during emulsification and outline how each of these flow profiles is effective in bringing about droplet disruption. **(15 marks)**

4. Answer the following in short lines

a. Colloid mill **(4 marks)**

b. Critical Micelle concentration **(4 marks)**

c. Marangoni Effect **(4 marks)**

d. Protein bridging **(4 marks)**

e. Hydrophobic interaction **(4 marks)**

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

6.

(a) In a tree-form, show the classification of liquids based on rheology **(4 marks)**

(b) Define each classification mentioned in (a) above **(10 marks)**

(c) What is the relevance of this classification to a food scientist? **(6 marks)**

7. A new firm has embarked on producing a salad dressing. During their product development stage, they noted that on letting the salad dressing to stand, creaming was experienced after a period of twenty (20) hours. Their Research & Development (R&D) Manager advised them to include a polysaccharide, **Dextran**, as a stabilizer to stop the creaming. Initially, he advised them to use 0.05% of dextran but still experienced creaming within fifteen (15) hours. After further consultations, the R&D Manager advised them to increase the concentration to 0.25% at which the creaming was completely halted.

(a) Explain the reason for the creaming during the initial stage of product development **(6 marks)**

(b) Explain the reason for the creaming experienced after addition of 0.05% dextran **(6 marks)**

(c) Give the possible reason and the phenomenon responsible for stopping the creaming after addition of 0.25% **(8 marks)**

8.

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

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

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

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

End of Exam

Formulae and constants for examination

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

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

$\Sigma = 1 / \Gamma$

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

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

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

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

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

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

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

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

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

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

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

$t_{1/2,\ rapid} = 3*\eta / (4*k*T*N_o) = 2*10^{17}/ N_o$

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

$F = 96485$ C / Mole

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

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

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

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

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

δ_{H2O} at 22°C ≈ 1000kg/m3

$g = 9.81$m/s

$\pi = 3.14$

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DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

First Semester Examination December 2008

AGF 531 EXAMINATION

TECHNOLOGY OF VEGETABLE PRODUCTS I

- Answer question 1 and any other 4 questions
- Each question carries 20 marks
- Time : 3 hours

1. a) Describe a caryopsis, giving the functions of the different parts, if any. **(8 marks)**

b) Describe the properties of acid modified starch. **(4 marks)**

c) Short answers

- aleurone layer
- sweet potato
- imbibition process
- massecuite
- mannitol
- acesulfame-K
- flint corn
- phytic acid

(8 marks)

2. a) Sugar for sweetening our food is mainly extracted from sugar beet and sugar cane.

i) What is sugar beet. **(3 marks)**

ii) How is sugar extracted from Sugar beet. **(10 marks)**

iii) What alternatives to sugar exist on the market. **(3 marks)**

iv) What are the advantages of these artificial sweeteners. **(4 marks)**

3. a) Starch is the most abundant polysaccharide in nature.

i) What is starch. **(4 marks)**
ii) How is starch obtained from corn? **(5 marks)**
iii) Describe the properties of starch that make it a highly utilised industrial product. **(4 marks)**

b) i) What is par-frying? **(1 mark)**
ii) Describe the changes that occur in potatoes when they are fried. **(3 marks)**
iii) Name four industrial uses of cassava starch **(3 marks)**

4. a) How does the baking quality of wheat determine the use of wheat flour. **(6 marks)**
b) Briefly describe one tuber crop that is a staple food for some populations in the world. **(4 marks)**
c) There are many problems that occur due to moisture migration in cereal storage bins caused by temperature fluctuations.
i) Explain what happens in the bin when the external temperature is high. **(6 marks)**
ii) Describe the problems that this situation may cause. **(4 marks)**

5. A Small-to-Medium-Enterprise (SME) is contemplating to invest in milling of maize. The company has approached you as a food technologist to make them have a good idea on what is involved in maize milling. They would like to be producing roller meal brands, breakfast meal brands and maize grits for the brewing industry. They are not familiar with the process required to produce such maize products. Outline to them the major steps in the process of producing such maize products. Explain the purpose of each step. **(20 marks)**

6. In bread making, a number of defects (bad quality) can occur to the final product after the bread has been produced and during storage of the bread.
    a. Mention three of the major defects you would expect **(4 marks)**
    b. Mention and explain the cause(s) of such defects **(8 marks)**
    c. What advice would you give to the bread producers to avoid or deal with such defects **(8 marks)**

End

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2008 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION

AGF 541 – Technology of Dairy and Egg Products

Instructions: Answer **Five (5)** questions; answer **Questions 1 & 2 and any third one from section one** and **any two (2)** from section two. Answer the **two sections in separate booklets**.
Marks allocated for each question are indicated at the end the questions.

Time allowed: Three (3) Hours

SECTION 1: Dairy Technology

1. Describe the hard cheese manufacturing process from reception to final product and explain how this differs from the soft cheese manufacturing process. **(15 points)**

2. You have just been employed by H.B Consulting Company and the general manager of Mpuno Dairy Corporation approaches you with the following problems:
   - the yoghurt takes too long or fails to set after inoculation.
   - in instances when the yoghurt sets, the coagulum separates on storage.

   Explain the possible causes of the problem to your client and offer possible solutions. **(13 points)**

3. Discuss the milk quality tests at the reception point and the cleaning systems employed in the dairy plant. **(12 points)**

4. Explain the factors affecting milk composition and their effects on the quality of dairy products. **(12 points)**

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

1. Describe four methods of prolonging the shelf life of eggs in the shell **(10 Points).**

2. Describe with a diagram how an egg in a hen is formed and describe possible defects and their causes during this process **(10 Points)**

3. Explain how eggs are classified, graded and defined in order to meet Legal and Quality Standards **(10 Points)**.

4. Explain the significance of the following in egg technology **(10 Points)**
    a. Free fatty acid in dried eggs
    b. α –amylase activity
    c. Candling
    d. Desugaring of eggs
    e. Egg pH

Good Luck!!

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

Third Year Examinations for Bachelor of Agricultural Sciences

AGG 311: EXPERIMENTAL DESIGNS AND STATISTICS

First Semester 2008/09

DATE: Friday December 5th 2008, PM. TIME: THREE HOURS

Answer five questions only. However Question 4 is compulsory **Marks**

1.0 Write short notes on the following: **20**

a) Correlation Coefficient
b) Methods of error control in scientific experimentation
c) The use of the Z and student's t Distributions in statistical inference
d) The Completely Randomized Design
e) The use of expected mean squares in Experimental design

20

2.0 A Plant Breeder has developed four Cassava Varieties using various Plant Breeding Methods. Before these varieties are officially released for commercial production, the Seed Control and Certification Institute (SCCI), conducts independent tests to verify the expression of various traits. Of particular interest in human health currently, is the Uptake Efficiency (UE) of selenium in cassava because of the importance of selenium in human diets to combat the effects of HIV/AIDS. The higher the selenium concentration in the cassava tuber the more efficient the variety is in selenium uptake

The data in the table below are selenium concentrations among the Five cassava varieties in parts per million (ppm)

VARIETY	REPLICATION					TOTALS
	1	2	3	4	5	
V1	2	2	10	6	4	**24**
V2 (Nalumino)	7	12	7	13	13	**52**
V3	9	13	13	14	14	**63**
V4	14	20	17	14	18	**83**
V5	2	5	6	10	6	**29**
TOTALS	**34**	**52**	**53**	**57**	**55**	**GT =251**

a) State the null and alternative Hypothesis
b) Analyze the data and test whether or not selenium concentration for the five cassava varieties are different.
c) If Varieties VI and V3 were developed using Conventional Plant Breeding Methods and varieties V4 and V5 were developed using Genetic Engineering techniques of gene transfer, the breeder is interested in comparison of the performance of V1 and V3 versus V4 and V5. Other comparisons are V1 versus V3; V4 versus V5 and lastly, Nalumino (V2) versus all the new varieties combined. Are there any differences in UE of selenium among these comparisons that the breeder should take note of.
d) What variety or varieties would you recommend the breeder to promote for commercial production?

20

3.0 Horticulturalists state that plants emit gases that trigger the ripening of fruit, attract pollinators, and influence other plant physiological responses. It is suspected that the weight of a plant has an influence on the amount of volatile gases emitted by the plant. The following data on plant weight (x) in kilograms and quantity of volatile compounds emitted (y), in hundreds of nanograms are for eleven (11) banana plants of diverse parentage.

x	57	85	57	65	52	67	62	80	77	53	68
y	8.0	22.0	10.5	22.5	12.0	11.5	7.5	13.0	6.5	21.0	12.05

a) Compute the regression parameters and show the Regression Prediction Formula.
b) Test whether the regression is statistically greater than zero.
c) Comment on your findings.

ANSWER QUESTION 4

20

4.0 It has been said that the problem of protein malnutrition among the people in Sub-Saharan Africa can be solved if scientists in the continent can get back to basics and improve the productivity of small livestock available at village level. The village chicken has been identified as potentially the cheapest and most available source of dietary protein.

The village chicken is able to scrounge for food from the environment without the intervention of the farmer with any regular feeding using expensive commercial feeds. It is said to have very high protein utilization efficiency. Empirical evidence has shown that a slight improvement in the management of these chickens can greatly improve their productivity.

A scientist in the Animal science Department, has genetically characterized and identified **Six (6)** most common and popular breeds of local village chickens in Zambia.

Design and clearly explain an experiment to study the response of the **Six** village chicken breeds to different feed protein concentrations and give the form of the ANOVA. The Feed Protein concentrations are as follows:

1. Free range type (no protein supplementation)
2. 25% of recommended commercial protein concentration
3. 50% of recommended commercial protein concentration
4. 75% of recommended commercial protein concentration
5. 100% of recommended commercial protein concentration

5.0 In his On-Farm trials to promote Conservation Farming (CF) methods Dr. K Munyinda decided to also investigate the influence of the education status of the farmers in technology adoption if any. He randomly sampled the CF adoption rate in Chibombo and Palabana areas where he was carrying out his on-farm research on CF techniques. The table below gives the education categories and number of farmers in each category who adopted the Conservation Farming technology. **20**

Education	Number of CF Technology adopters
Grade 7 or less	18
Grade 8 to 9	48
Grade 10 to 12	49
College	13

a) What is the null and alternative hypotheses
b) Do the data provide sufficient evidence to indicate that the adoption rate of CF methods by farmers is affected by the education status of the farmer?
c) What strategy should the promoters of CF use to enhance adoption of this technology in light of your findings?

6.0 Recent research findings from the International Plant Genetic Resources Institute (IPGRI) have shown that Livingstone Potatoes (Umumbu as it is called in Kapirimposhi) are very high in β carotene. This information has led Government to decree that cultivation of this crop using scientific agronomic methods be started in Zambia right away because of the potential the crop as an important food and feed crop. 20

Two factors are said to influence the β carotene content of Livingstone Potatoes, these being Genotype and Soil Nitrogen. The genotype or factor A comprised of

two local varieties and Soil Nitrogen or Factor B were two rates, that is, 50kg/ha N and 100kg/ha N. The response variable is β carotene concentrations in micro grams (μ grammes). Data is presented in the table below.

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

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

20

7.0 Three water samples were taken from each of three locations suspected of having high concentrations of fluoride which is defacing people's teeth through browning the teeth.

Two determinations of fluoride content were performed on each of nine samples. Shown in table below.

Data are in milligrams fluoride per liter of water

Locations	1			2			3		
Samples	1	2	3	1	2	3	1	2	3
	1.1	1.3	1.2	1.3	1.3	1.4	1.8	2.1	2.2
	1.2	1.1	1.0	1.4	1.5	1.2	2.0	2.0	1.9

a) Analyze the data and draw conclusions
b) What type of design is this

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

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS-NOVEMBER, 2008

AGS 311: AGROCLIMATOLOGY

Time: Three (3) Hours Total Marks: 100
Instruction: Answer all questions

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1. Briefly define each of the following terms *(20 marks)*
   a) Lower lethal temperature
   b) Mixing ratio
   c) Planetary boundary layer
   d) Greenhouse effect
   e) Grey body

2. Temperature has direct effects on agricultural pest organisms. What mechanisms organisms developed in order to regulate and compensate temperature change? *(20 marks)*

3. In its passage through the atmosphere, solar energy is depleted through an number of processes: *(20 marks)*
   a. What are the main processes?
   b. What constituents of the atmosphere take significant part in solar absorption?

4. With an aid of a diagram, show how temperature in the earth's atmosphere varies with altitude and indicate the main causes of these temperature changes *(10 marks)*

5. There has been significant level of consensus amongst scientists that there has been a global precipitation change on Earth. What are these globally agreed changes? *(10 marks)*

6. Given the following meteorological data measured this year for Mount Makulu, Chilanga (28°15′ E, 15°33′ S and altitude 1213 m): ***(20 marks)***

Maximum daily temperature	25.9°C
Minimum daily temperature	11.7°C
Mean Relative Humidity	44 %
Minimum Relative Humidity	26 %
Sunshine duration	9.40 hours
Wind speed at 10m height	227 km day^{-1}
Estimated extraterrestrial radiation	358.788 W m^{-2}
Solar declination angle	0.233 radians

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

Determine:

a) Wind speed at standard height of 2m above the ground surface (*in* ***m/s***)
b) The day and month of this measurement
c) Actual vapour pressure in ***kPa***
d) Solar radiation in ***MJ m^{-2} d^{-1}***
e) Sunset hour angle ***in degrees***
f) Time of sun-rise and sunset on this day

End of Exam

THE UNIVERSITY OF ZAMBIA EXAMINATIONS

AGS 431

SOIL MINERALOGY AND MICROMORPHOLOGY

November 25, 2008

INSTRUCTIONS

Time: 3 Hours. **Answer all questions.** **Marks: 100**

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1. Define the following terms: ***(12 marks)***
   a. Siallitisation
   b. Ferralitization
   c. Fersiallitization
   d. Simatization
   e. Pleochroism
   f. (001)
   g. Short range order mineral
   h. Crossed polarized light

2. One difference between the soils of Northern Zambia and those of Southern Zambia is that the soils of Northern Zambia are more highly weathered than those of southern Zambia. ***(20 marks)***

   a. What is the main factor contributing to this difference? Give a short explanation of how this factor is responsible for the differences in soil properties. *(4 marks).*

   b. What role do the following play in the weathering process of soils:
      i. Organic matter? *(4 marks)*
      ii. Leaching of the bases? *(4 marks)*
      iii. High levels of hydrogen ion? *(4 marks)*
      iv. Fixation of cations? *(4 marks)*

3 With the help of diagrams clearly show the differences between the structures of Vermiculite and Chlorite and explain the difference in the magnitude of their negative charge.
(14 marks)

4 The coarse clay fraction of a soil composed of muscovite, $KAl_2(AlSi_3)O_{10}(OH)_2$, kaolinite $Al_2Si_2O_5(OH)_4$, goethite (FeOOH) and quartz (SiO_2) contains 4 % Fe and 3.2 % K. A thermal gravimetric analysis of 150 mg of the clay fraction shows a weight loss of 9 mg at 550°C. Assuming that all the Fe in the clay is associated with goethite while all the K is associated with muscovite and that the weight loss at 550° C is due to dehydroxlation of kaolinite, answer the following: ***(14 marks)***

a. Calculate the percentages of muscovite, kaolinite, goethite, and quartz present in the clay fraction of this soil. Show calculations to support your answers. *(8.0 marks)*

Note: Atomic masses in grams: Fe=56, Al=27, Si=28, O=16, H= 1 K=39

b. When heated from 25 °C to 1000°C, quartz undergoes an exothermic phase change at 573.3 °C which is not accompanied by a change in weight, while goethite undergoes a loss of hydroxyl ions at 400° C and kaolinite loses its hydroxyl ions at 550° C. Sketch the DTA and TGA thermograms you would obtain if this sample is subjected to DTA and TGA between 25 and 1000°C. (3 marks)

c. If the CEC of kaolinite is 5cmol (+).kg^{-1} that of the other minerals present in the clay is 0 cmol (+).kg^{-1}, calculate the CEC of this clay in meq/100 grams of clay. (3 marks)

5 A petrographic study of an apatite rich sand fraction of a soil sample from Chongwe District involving a count of 400 sand grains showed that the soil had 47 grains of apatite, 28 grains of calcite, 98 grains hematite, 52 grains biotite, 150 grains of quartz, and 25 grains of other unknown minerals. ***(13 marks)***

a. What is your assessment of the inherent fertility status of the sand fraction of this soil? Give reasons to support your answers.(5 marks)

b. What is the 95 % confidence interval of the proportion of calcite in this sample? ($Z_{0.025} = 1.96$) (3 marks)

c. If the proportion of quartz in the apatite rich sand fraction of soils from Kaluwe in the Rufunsa area of Chongwe District was found to be 40 %, test the hypothesis that the proportion of quartz in the new sample from Chongwe is the same as that of the soils from Kaluwe at 95 % level of confidence. Show calculations to support your conclusion. (5 marks).

6 A deposit of an economically important agricultural mineral has recently been discovered in a village in Kalomo District of the Southern Province of Zambia. A sample of the mineral in this deposit was analyzed and results of the mineralogical analyses are presented below.

Specific gravity = 3.15g.cm^{-3}
Crystallographic axe of unit cell s: a= 0.937 nm, c= 0.688 nm, b = 0.688 nm
$\alpha = 90, \beta = 90, \gamma = 120$
Optical properties: $n\omega=1.628$, $n\varepsilon=1.633$

Answer the following questions: ***(27 marks)***

a. To what crystal system does this mineral belong? Give reasons to support your answer? *(3 marks)*

b. What is the axial ratio of this mineral? *(2 marks)*

c. If the c- axis of this mineral corresponds to a six-fold axis, draw a schematic diagram of the unit cell of this crystal, showing the various angles and crystal axes. *(3 marks)*

d. Is this crystal an open or closed form? Give reasons to support your answer? *(2 marks)*

e. What is the thickness of the unit cell of this mineral along the crystal axis [001]? *(1 marks)*

f. If this mineral is adjacent to chlorite in a thin section and the refractive index of chlorite is 1.57, towards which mineral will the Beck line move when the thin section is brought out of focus on a petrographic microscope by increasing the distance between the sample and the objective lens? Give reasons to support your answer. (2.0 marks)

g. What is the birefringence of this mineral? *(2.0 marks)*

h. Is this mineral uniaxial positive or uniaxial negative? Give reasons to support your answer. *(2 marks)*

i. If this mineral is subjected to a density separation using bromoform as the separating fluid, in which density fraction would this mineral be found? Give reasons to support your answer. *(2 marks)*

j. The most intense peaks of d-spacings of minerals on the diffractogram of powdered sample of the rock from Kalomo when analyzed with Cu kα radiation ($\lambda = 0.154$ nm.) are observed at 2θ values of 20.8°, 25.8°, 26.7°, 32.2° and 33.4°. Using the data of X-ray diffraction peaks of some important agro minerals given below, identify the mineral present in the deposit discovered in Kalomo District. Show all the calculations used to arrive at your answer. *(6.0 marks).*

Note: the sample also contains a common silicate mineral, which is not an agro-mineral.

Prominent d-spacings (nm) and corresponding intensities (in brackets) for some important agricultural minerals

Gypsum		Calcite		Dolomite		Apatite	
d	I	d	I	d	I	d	I
0.761	45	0.304	100	0.289	100	0.346	25
0.428	90	0.250	14	0.219	19	0.278	100
0.287	100	0.229	18	0.202	10	0.268	40
0.268	50	0.210	16	0.178	13	0.223	16

k What is the agro mineral present in this deposit used for in crop production? (2 marks)

END OF EXAM

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS-NOVEMBER, 2008

AGS 441: AGRICULTURAL HYDRAULICS AND HYDROLOGY

Time: Three (3) Hours Total Marks: 90
Instruction: Answer all Questions, Appendix tables provided

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1. Briefly define each of the following terms *(20 marks)*
   a) Flume
   b) Pumping head
   c) Stagnation point
   d) Piston pump
   e) Cavitation

2. Although there are obvious physical differences between channels and pipes, there are several important hydraulic differences between them: Briefly outline these hydraulic differences *(10 marks)*

3. A vertical rectangular sluice gate of dimensions of 1.0m high by 0.5m wide located 2.3m below the water surface. Calculate: *(10 marks)*
   a. The horizontal force on the gate
   b. The location of the horizontal force on the gate

4. A hydraulic jump occurs in a rectangular channel 2.3m wide when the discharge is $2.5m^3s^{-1}$. If the upstream depth is 0.25m, Calculate *(12 marks)*
   a. The Froude number
   b. Depth of flow downstream of the jump
   c. The Energy loss in the jump

5. In an unconfined aquifer having coefficient of permeability of 10^{-3}m/sec, resting above an impervious base, a fully penetrating well of diameter 30cm draws a steady state discharge of $120m^3$/hour. Due to pumping the water table is lowered by 1.5m at a point 12m from the centre of the well. If the water table was 15m above the impervious base before the pumping started, compute: *(14 marks)*

   a. The drawdown at (*i*) 30m and (*ii*) 50m
   b. The radius at which the drawdown is negligible (*in m*)
   c. The thickness of the unconfined aquifer (*in m*)

6. A pivot irrigation system was recently installed for a 25ha wheat field at UNZA Farm. If the pumps selected were based on manufacturers' pump curves and the following site data: *(24 marks)*

Parameter	Value
Hydraulic head	23 m
Discharge	70 m^3/hr
Elevation	2000 m
Static suction	2 m
Suction pipe friction losses	0.5 m
Maximum temperature	35°C

a. Calculate the NPSHA of the pump, select a suitable impeller size to be used and estimate the efficiency of the pump *(12 marks)*

b. With the aid of diagrams, describe the different characteristic curves for selecting irrigation pumps and their application *(12 marks)*

End of Exam

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS – NOVEMBER 2008

AGS 511

SOIL CHEMISTRY

TIME: THREE HOURS

INSTRUCTION: ANSWER ALL QUESTIONS (POINTS IN PARENTHESIS)

1. A farmer from the Gwembe Valley has brought in a soil sample for analysis. When you suspend the soil in solution, it remains dispersed and cannot be filtered.

   a. How would you immediately go about trying to flocculate and filter this soil suspension while it is still in the filter paper? (3 points)
   b. Identify and define the ionic strength, dielectric constant, temperature and valence components of the diffuse double layer equation given:

   $$DDL = \frac{\sqrt{DKt}}{\varepsilon\sqrt{8\pi}\sqrt{\mu}}$$

   and for each component explain how you could manipulate it in the laboratory in order to achieve your desired result to filter the suspension? (12 points)

2. Given the data below, determine if the adsorption of 2,4,5-T conforms to the Langmuir or the Freundlich models. Present a graph and explain your rationale. (10 points)

Initial Solution Concentration ($mg\ l^{-1}$)	Final Solution Concentration ($mg\ l^{-1}$)	Volume of solution (ml)	Weight of Soil (g)
5	3	10	5
10	6	10	5
25	15	10	5
50	30	10	5
100	70	10	5

3. How do the following factors affect anion repulsion:
   a. Anion charge
   b. Anion concentration
   c. Exchangeable cation
   d. Soil pH
   e. Other anions (15 points)

4. Calculate the dissociation constant (K) value for the dissolution of gibbsite:

$$\gamma\text{-Al(OH)}_{3\,(\text{gibbsite})} + 3H^+ \leftrightarrow Al^{3+} + 3H_2O \qquad \text{(15 points)}$$

given standard free energies:

Species	ΔG_f^o (kJ mol^{-1})
Al^{3+}	-117.33
γ-Al(OH)$_3$	-276.43
H^+	0.0
H_2O	-56.687

universal gas constant is 0.008314 kJ K^{-1} mol^{-1}, and temperature is absolute temperature.

5. Zambia has vast land resource for agriculture yet low soil productivity is a real challenge to crop production. Discuss in a generic manner the soil orders and properties of these soils found in the agro-ecological region III of Zambia. If there are limitations to their use, what are the chemistry limitations and why are they limitations. What are the possible remedies to make these soils useable for crop production? (15 points)

6. Assuming that layer silicates and organic matter exist independently in the soil, calculate a reasonable cation exchange capacity of soil containing:
   a. 40% montmorillonite and 3% organic mater.
   b. 40% kaolinite and 3% organic matter
   c. 20% illite and 1.5% organic matter
   d. 10% montmorillonite, 2% kaolinite and 5% organic matter
   e. How realistic are such calculations? (15 points)

7. For a CEC procedure that uses Na^+ as the index cation, H_2O/ethanol as the wash solvent, and Mg^{2+} as the displacing cation, discuss the effect of each of the following on CEC measurements:
   a. Hydrolysis due to excess washing
   b. Presence of large amounts of lime or gypsum in the soil
   c. Incomplete index-cation saturation
   d. Precipitation of an insoluble Na^+ salt in the ethanol
   e. Incomplete removal of the index cation by Mg^{2+} (15 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMMESTER EXAMINATIONS: DECEMBER 2008

AGS 531: LAND EVALUATION AND IMPROVEMENT

INTRUCTIONS: Answer all questions TIME: 3 Hours TOTAL MARKS: 95

1. State whether each of the following statements is **TRUE** or **FALSE**: **(10 Marks)**

   a) In the land evaluation and site assessment model, site factors are included because social, economic and geographical factors contribute to agricultural land suitability.
   b) The final recommendation of a land use plan is a function of the input-output relations of the various land use systems.
   c) A land characteristic is an attribute of the land that can be measured or estimated.
   d) Adaptation of land utilization refers to the transformation that can be made to it so that it can cope with the limitation found on the land.
   e) The parallel approach to land evaluation is more direct and facilitates a multi-disciplinary interaction in the early stages of the land evaluation.
   f) In the FAO land evaluation method, the land suitability subclass reflects the type of limitation or improvement measures in a given class.
   g) Land mapping units are mapped areas of the land.
   h) In the main stage of land evaluation, the land is delineated and mapped into various land units.
   i) The Riquier method for general land evaluation follows the Storie Index procedures, using 10 major factors.
   j) A land evaluation unit refers to one or more land mapping units offering the same possibilities for a given type of use.

2. Define the following terms: **(18 Marks)**
   a) Agro-ecological Zone
   b) Land suitability criteria
   c) Land tenure
   d) Management land quality
   e) Project zone of influence
   f) Matching

(TURN TO NEXT PAGE)

3. After a semi-detailed soil survey of a project site for maize production the following were the map units:

Soil map unit	Area covered (Ha)	Land Capability Classification	Storie Index (%)
1	1.3	IVw	21.3
2	4.5	IIe	66.4
3	4.0	IIIs	40.0
4	5.2	IIs	60.5

Using the land evaluation worksheet provided and appropriate charts and showing your working on a separate sheet find:

a) The total project area in acres. **(3 Marks)**
b) The total Land Capability Classification (LCC) score. **(5 Marks)**
c) The total Storie Index score. **(5 Marks)**
d) Using the total Storie Index calculated in question (c), above, what would be the maize yield at this project site assuming that the maximum yield of this crop is 12 tons/ha? **(5 Marks)**

4. a) The fact that adverse environmental issues arise does not preclude agricultural development projects. Explain why? **(4 Marks)**
b) In some land evaluation projects, the human factor may downgrade the suitability of a project. Explain why? **(6 Marks)**
c) List three classes of environmental concerns that relate to agricultural development. **(5 Marks)**

5. Given a land unit described by the soil profile in Annex 1, find the Storie Index given that factor A is rated at 85%. Show all your workings clearly. **(9 Marks)**

6. Explain in detail the main land characteristics that define Zambia's Agro-Ecological Zones. **(10 Marks)**

7. You are provided with Soil Profile Pit No. 3 from Solwezi State Farm.
a) Using the Zambian Land Capability Classification System evaluate the land unit represented by this soil profile. **(5 Marks)**
b) Explain one basic assumption regarding the use of this land evaluation system that you have violated in answering question 7 (a) above. **(3 Marks)**
d) Explain the main weaknesses of the Zambian Land Capability Classification System. **(7 Marks)**

END OF EXAM

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS, DECEMBER 2008

EA 311 (FARM POWER AND MACHINERY)

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: THIS EXAMINATION PAPER HAS **TWO** SECTIONS. ATTEMPT **FIVE** QUESTIONS ONLY, **AT LEAST TWO** FROM EACH SECTION. ALL QUESTIONS CARRY EQUAL MARKS.

SECTION A:

Question 1

a) A farmer has a pair of oxen, each weighing 400 kg that he uses for ploughing. The plough cuts furrow slices that are 20 cm wide by 12.5 cm deep. The specific soil resistance is 5 N/cm^2 and the oxen have a working speed of 3.6 km/h. Assume that the animals work for six (6) hours each day.

i) If the oxen are fed on average quality hay, show that they would need supplementary feed when ploughing if they have to meet their total daily energy requirement.

[10 marks]

ii) How much groundnut cake supplement would be required per ox per day to meet the total daily energy requirement?

[6 marks]

Table Q1. Energy content of typical animal feeds

Feed	Dry Matter (%)	Gross Energy of Dry Matter (MJ/kg)	$\frac{DE}{GE}$
Guinea grass	26	7.4	0.50
Sudan grass	31	17	0.65
Hay (average quality)	85	17	0.55
Maize silage	27	18.8	0.75
Maize grain	86	19	0.80
Groundnut cake	90	20.7	0.85

Additional Information

- Maintenance Energy = 8.3 + (0.091W) MJ/day
- Appetite Limit = 0.025W kg of dry matter
- Metabolisable Energy (ME) = 0.8 of Digestible Energy (DE)
- Energy Conversion Efficiency of Draft Animals = 20%

b) List any **four** characteristics of ideal draught cattle.

[4 marks]

Question 2

a) Briefly explain the following terms:
   i) ATP
   ii) Glycolysis
   iii) Basal Metabolic Energy

[6 marks]

b) State **two** factors that can limit continuous work when carrying out manual work, and briefly explain how.

[4 marks]

c) Human beings take in food, that can be considered as chemical energy and oxygen and gives out carbon dioxide, water and energy just like heat engines take in fuel that is equally considered as chemical energy and oxygen and gives out carbon dioxide, water and energy. List **five** differences between human power and mechanical power?

[10 marks]

Question 3

a) Very briefly explain how formation of a cooperative by small scale farmers to acquire farm machinery for common use by members can help them lower crop production cost.

[4 marks]

b) A farmer who recently acquired 450 hectares of cleared land in Serenje District where he intends to grow maize under rain-fed condition is considering buying a *Massey Ferguson MF400* tractor and a 3 metre wide *Ransomes* chisel plough that he would use for primary tillage. Assume ploughing speed of 8 km/h and field efficiency of 75%. Additional information is provided in the table below:

	Tractor	**Plough**
Purchase price, P	ZMK 80,000,000	ZMK 10,000,000
Trade-in value, S	10% P	0
Shelter/Insurance/Tax	5.0% P	1.0% P
Economic life	10 years	5 years
R&M (cumulative over first 4 years)	20% of P	50% of P
Fuel Consumption	12 l/h	-
Price of Fuel	ZMK 6,500/l	-
Cost of lubricants	15% of Fuel Cost	-

Labour cost is ZMK 5,000 per hour and the bank interest rate is 20%.

Apart from ploughing his own field, the farmer sees an opportunity to hire out the tractor and plough to neighbouring farmers. It is estimated that the tractor and plough would be hired out to other farmers for an additional 750 work hours per year.

i) Calculate the effective field capacity.

[3 marks]

ii) Calculate total annual use of the tractor and the plough (in hours).

[3 marks]

iii) If the Zambia National Service (ZNS) provides a tractor hire service in the area for ZMK75,000 per hectare, advise the farmer whether to go ahead to invest in his own tractor and plough or to use the tractor hire service from ZNS. Explain your answer. Clearly show all the calculations necessary to arrive at a sound conclusion.

[10 marks]

Question 4

a) Define the following terms:
   i) engine
   ii) engine displacement
   iii) clearance volume
   iv) firing order

[4 marks]

b) State the function(s) of the following components of an engine:
   i) crankshaft
   ii) compression rings
   iii) flywheel
   iv) cylinder head gasket
   v) valves

[10 marks]

c) A six-cylinder, four-stroke cycle, vee diesel engine operates at 3,000 rpm and has a fuel consumption of 15 litres per hour.
   i) Calculate the total number of power strokes per minute.

[3 marks]

   ii) Calculate the average volume of each fuel injection (in cubic millimetres).

[3 marks]

SECTION B:

Question 5

a) For each of the following tillage objectives on fields located within Lusaka Province, state one implement that would best accomplish each task. Very briefly justify your choice.
   i) Clean tillage around mid-January in a field that has a lot of crop residue and weeds.
   ii) Conservation tillage in the month of May in a field that is prone to wind erosion and has developed a medium strength hard pan due to repeated use of a disk plough.
   iii) Very fine tilth seedbed preparation for rape seeds in one pass.
   iv) Primary tillage just before the on-set of rains in October of a field with dry and brittle soils that have outcrops of stones and roots.

[8 marks]

b) i) With reference to Figure Q5, name the implement and state what field operation it is used for.

[4 marks]

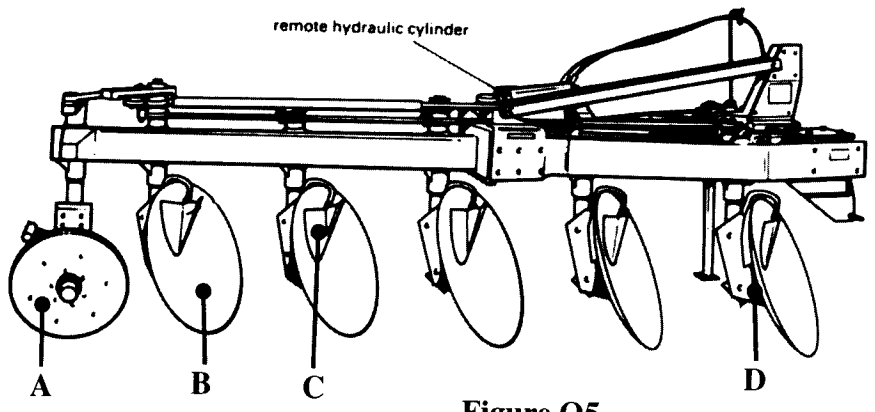

Figure Q5

   ii) Name the parts A, B, C and D in Figure Q5 and for each part state its function(s).

[8 marks]

Question 6

a) State **two** aspects of crop planting that are examined during calibration of a seed drill.

(4 marks)

b) A farmer would like to plant 75 kg/ha of wheat seed using his 10 x 250 mm seed drill. The seed metering mechanism for the seed drill is driven by 1273 mm diameter seed drill wheels via a chain and sprocket linkage.

i) Calculate the width of the seed drill.

(2 marks)

ii) the length of travel necessary for the seed drill to cover 0.25 ha.

(2 marks)

iii) the number of wheel revolutions needed to cover an equivalent of 0.25 ha.

(2 marks)

iv) the amount of seed expected from each seed delivery tube.

(2 marks)

After static calibration, the seed hopper was filled with 330 kg of wheat seed, which reduced the drive wheel rolling radius to 579 mm after jacking down the seed drill.

v) Briefly explain the effect that the reduction in the seed drill drive wheel rolling radius will have on the seed rate.

[2 marks]

vi) Calculate the seed rate (kg/ha) with reduced drive wheel rolling radius. And if the farmer goes ahead to plant the seed without further adjustment on the seed metering unit, determine the area the wheat seed will cover before it runs out?

[4 marks]

c) What influence will increasing seed drill speed have on the amount of seed planted per hectare.

[2 marks]

Question 7

a) Briefly explain the following terms:
   i) Pesticide formulation
   ii) Foliar systemic herbicide
   iii) Pesticide drift

[6 marks]

b) A farmer would like to apply 121 l/ha of a certain pesticide using a tractor-mounted sprayer. Only one set of nozzles is available and each nozzle has a flow rate of 1.51 litres/minute when operating at a pressure of 4 bars. If the sprayer has 40 nozzles spaced 75 cm apart, what tractor speed is required to apply the correct amount of the pesticide?

[5 marks]

c) If the operating speed of the tractor had to be limited to 7.5 km/hr due to rough field surface, calculate the pressure at which the sprayer should be operated in order to maintain the pesticide application rate of 121 l/ha.

[5 marks]

d) State **two** ways of changing the pesticide application rate (l/ha) without necessarily changing the nozzle size fitted on the sprayer?

[4 marks]

END OF THE EXAMINATION!

Develop a passion for learning. If you do, you'll never cease to grow.
Anthony J. D'Angelo

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATION – DECEMBER 2008

AGS 551: PLANNING IRRIGATION AND DRAINAGE

TIME ALLOWED: 3 Hours **MARKS: 100**

INSTRUCTIONS:

i) **Answer all questions in section A and any Two (2) in section B**
ii) **Use of Calculators is permitted**

SECTION A

QUESTION 1

In its quest to attain household and national food security, the Ministry of agriculture has decided to allocate land to retired Office of the President personnel. The retirees were encouraged to grow at least 5 hectares of winter wheat on their 2 plots measuring **200m by 125m** each. This area has clay-loam type of soils whose available water holding capacity is 110mm/m. The infiltration capacity of this soil is 6.0mm/h. If the following is the case:

a. Select the most appropriate sprinkler Configuration from the Table 1 if the application efficiency is 70% and give reasons for your choice *(5 Marks)*

b. Using your selected Sprinkler Configuration compute: *(6 Marks)*
   i. the number of sprinkler positions on the lateral (n);
   ii. the number of lateral position on the Mains (p)

c. If two (2) laterals are used to irrigate the plot at once, what should be the discharge of the pump? *(4 Marks)*

d. What would be the: *(6 Marks)*
   i) Set time if the crop evapotranspiration was 4.5mm/d?
   ii) The duration of irrigating the entire fields if 15 minutes is required to move the equipment?

e. Discuss factors affecting the performance of sprinklers in the overhead irrigation. *(4 Marks)*

Table 1 Sprinkler Specifications

Nozzle Aperture (mm)	Operating Pressure (bar)	Throw (m)	Flow q (m^3/h)	APPLICATION RATE (mm/h) Sprinkler spacing (m)	
				12 x 18	18 x 18
4.2 x 2.4	2.5	14.5	1.45	6.6	4.6
	3.0	15.0	1.55	7.2	4.8
	3.5	15.5	1.66	7.7	5.1
	4.0	16.0	1.78	8.2	5.5
4.8 x 2.4	2.5	15.4	1.70	7.9	5.2
	3.0	15.8	1.86	8.6	5.7
	3.5	16.2	2.00	9.3	6.2
	4.0	16.6	2.20	10.2	6.8
5.2 x 2.4	2.5	15.6	2.00	9.2	6.2
	3.0	16.0	2.20	10.2	6.8
	3.5	16.4	2.24	11.0	7.2
	4.0	16.8	2.51	11.6	7.7

QUESTION 2

a. If you are an Irrigation specialist, advice a group of upcoming farmers on variables which one needs to consider when selecting a Surface Irrigation Method. ***(5 Marks)***

b. Elaborate some of the causes of the uneven distribution, low irrigation Efficiency in basin irrigation ***(5 Marks)***

c. In the central province of Zambia surface irrigation method is being practiced. If the net peak crop water requirement is 5mm/day, while the available moisture for the soil is assumed to be 65 mm/m. The fraction P (depletion) allowed is 65%. If the root zone depth is 0.90m, what is the irrigation frequency? ***(10 Marks)***

d. Given that the net irrigation depth is equal to the readily available moisture and considering a field application efficiency of 55%, what is the gross irrigation requirement? Use the figure 1 to determine the contact time. ***(5 Marks)***

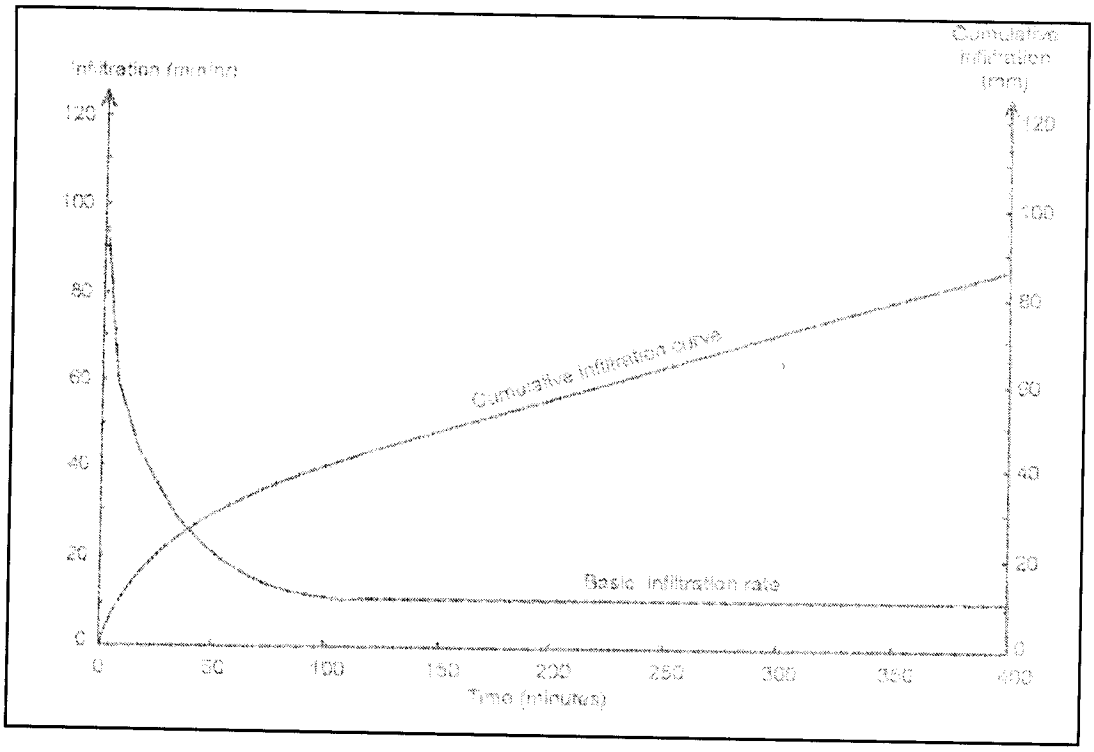

Figure 1 Infiltration Test Data

SECTION B

QUESTION 3

a. Discuss the Merits and Demerits of drip irrigation in Zambia ***(5 Marks)***

b. With aid of well labelled sketch, describe a small-scale drip irrigation system ***(10 Marks)***

c. The use of the Centre Pivots is growing, discuss why? ***(10 Marks)***

QUESTION 4

a) How can knowledge of the source of irrigation water be useful in solving a drainage problem? ***(6 Marks)***

b) Discuss why irrigation and drainage are complementary in arid regions ***(9 Marks)***

c) Discuss the rationale for drainage in Zambia? List effects of poor drainage. ***(4 Marks)***

d) Compare surface and subsurface drainage methods with aid of sketches. ***(6 Marks)***

QUESTION 5

Compare **Border strip** and **Basin** irrigation methods under the following headings:

(25 Marks)

i. Stream size
ii. Field size and shape
iii. Cultivation practices
iv. Water management
v. Efficiencies

QUESTION 6

a) What are factors that influence the adoption of furrow irrigation method?

(5 Marks)

b) Determine the number of furrows to irrigate given a stream flow of 360 m^3/hour and a siphon discharge of 2 litres per second. *(5 Marks)*

c) Determine the maximum non-erosive flow (M.N.E.F) for a furrow irrigation system in which water will flows at a rate of 2 litres per second over a gradient of 1:1000 *(10 Marks)*

d) What variables affect water distribution in furrow irrigation methods

(5 Marks)

QUESTION 7

a) In what ways would the irrigation in the Zambia's Agro-ecological Zone 3 differ from that in Zone 1? *(9 Marks)*

b) Elucidate how the following factors influence the adoption of Irrigation: Poverty, Population, HIV- AIDS, Government Policy, Climate change

(10 Marks)

c) Discuss Subsurface irrigation and list some examples *(6 Marks)*

End of Examination