THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURE

2018/2019 ACADEMIC YEAR EXAMS

1.	AGA 3212	APPLIED ANIMAL NUTRITION
2.	AGA 4311	PRINCIPLES OF GENETICS
3.	AGE 5151	INTERNATIONAL AGRICUTURAL MARKETS, TRADE AND DEVELOPMENT
4.	AGE 5241	PRINCIPLES OF FARM MANAGEMENT (DEFFERED)
5.	AGE 5251	AGRICULTURAL PROJECT PALANNING AND APPRAISAL
6.	AGF 2015	FUNDAMENTALS OF ORGANIC CHEMISTRY
7.	AGF 3021	CHEMICAL TECHNIQUES IN FOOD ANALYSIS (THEORY)
8.	AGG 3811	RURAL SOCIOLOGY
9.	AGG 3822	AGRICULTURAL EXTENSION EDUCATION
10.	AGG 3832	FORAGE CROP PRODUCTION AND RANGE MANAGEMENT
11.	AGN 2110	HUMAN ANOTOMY AND PHYSIOLOGY
12.	AGS 2110	FUNDAMENTALS OF SOIL SCIENCE
13.	HME 3522	QUANTITY FOOD MANAGEMENT AND FOOD SERVICE EXAM

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIERNCES
DEPARTMENT OF ANIMAL SCIENCE
2019 END OF THE YEAR FINAL EXAMINATIONS
AGA 3212 – APPLIED ANIMAL NUTRITION

INSTRUCTIONS

Answer any five questions from the six provided.
Write your answers for each section in a different answer booklet
All question carry equal marks (20 Marks each)

SECTION A – FEED CLASSIFICATION

QUESTION 1

(i) Define the term 'roughages' as used in livestock feeding. Give an outline of how they (roughages) are classified. **(10 Marks)**

(ii) What are feed additives? For any three (3) classes of feed additives that you know give an example and explain how that particular additive is able to achieve the specific purpose that it is included in the ration. **(10 Marks)**

QUESTION 2

(i) Fish meal is known to be a good source of protein. However it is not much used in Zambian stock feeds, and when used it may be used in restricted amounts. Discuss briefly the reasons that you consider to be the main contributing factors to this state of affairs. **(10 Marks)**

(ii) Explain why maize and soybean meal are the most used energy and protein sources in livestock feed, respectively. **(10 Marks)**

SECTION B – RATION FORMULATION FOR MONOGASTRICS

QUESTION 3

(a) Formulate a 100kg complete broiler grower ration with 20% CP, 0.5% Ca, and 0.65% P, using the ingredients shown in Table 1. In your formulation, the Maize bran, fish meal, salt, broiler premix and Zinc bacitracin should be fixed at 5, 6, 0.5, 0.35, and 0.01%, respectively. Also, the full fat soybean meal (FF-SBM) and low fat soybean meal (LF-SBM) should be in a 9:1 ratio in the ration. **(16 Marks)**

Table 1: Nutrient composition (g/kg DM) in feed ingredients used in the formulation for broiler grower.

Ingredient	Protein	Calcium	Phosphorus	Crude fiber
Maize	88	0.5	2.7	22
Wheat bran	154	0.13	11.3	100
Low fat -SBM	390	2.6	6.1	31
Fish meal	701	22	1.7	10
Full fat - SBM	450	2.4	5.7	28
DCP	0	240	182	0
Limestone flour	0	371.1	0	0
Salt	0	0	0	0
Broiler premix	0	0	0	0
Zinc bacitracin	0	0	0	0

(b) Calculate the total crude fibre content of your feed **(4 Marks)**

QUESTION 4

(i) Using the Pearson square method, formulate a concentrate mixture for goats to have 18% digestible crude protein (dCP) and 74% total digestible nutrients (TDN). The ingredients to use are maize meal, Rhodes grass hay, and cotton seed meal. The composition of the mentioned ingredients is as given in the Table below. **(14 Marks)**

Table 2: Nutrient composition (%) in feed ingredients used in the formulation of the concentrate mixture for goats.

Ingredient	TDN%	dCP%	Calcium (%)	Phosphorus (%)
Maize meal	84	8.8	0.03	0.26
Rhodes grass Hay	56	6.4	0.04	0.34
Cotton seed meal	68.8	40.9	0.20	1.05

(ii) How much Calcium and Phosphorus does the ration you have formulated contain? **(6 Marks)**

SECTION C – RATION FORMULATION FOR RUMINANTS

QUESTION 5

A) Assume you have a herd of beef cattle consisting of a bull, 2 oxen, 6 nursing cows, 7 dry cows, 5 two-year old replacement heifers, 7 one-year old replace heifers and 6 calves. If a bull is equivalent to 1.2, an oxen to 1.4, a cow to 1.0, a 2-year old heifer to 0.7, a 1-year old replacement heifer to 0.5 and a calf under 1 year to 0.3 livestock units (LU), how many livestock units are in the above mentioned herd? You are then supposed to prepare for a 5-months dry season feeding period by producing and buying fodder for the animals. The production of fodder is based on the crops tabulated in **Table 3.** How much fodder will you expect to produce and how long is it supposed to last on the farm if the animals were consuming 10 kg dry matter (DM) per day per Livestock Unit (LU)?

Table 3: Expected fodder production from on-farm crop and pasture production operations.

Crop	Hectares	Type of fodder	Expected Yield	DM Content
Maize	2.0	Stover	5 tons/ha	80%
Millet	1.5	Straw	3.5 tons/ha	78%
Rice	2.3	Straw	3 tons/ha	72%
Star grass	2.5	Hay	5 tons/ha	67%
Siratro	2.0	Hay	4 tons/ha	70%
Lucerne	2.5	Hay	3 tons/ha	60%

B) If you have to buy 5:1grass to legume hay mixture to take the animals through the dry season. How much grass and legume hay are you supposed to buy if the grass and legume hays each contain 60 and 55%DM. What is the TDN and dCP concentration on as fed basis in the grass and legume hay mixture assuming the grass had 660 g TDN and 80 g dCP per kg DM; while the legume had530 g TDN and 115 g dCP per kg DM.

QUESTION 6

A). Assume you have a 400kg Jersey dairy cow that is producing milk with 4.5% butter fat content and the animal depends on a natural grass that contains 32% dry matter (DM)with a total digestible nutrient (TDN)concentration of 650g and a digestible crude protein (dCP) content of 90g per kg dry matter. If the cow consumes 2.5% of its body weight as DM feed intake each day, how much of this natural grass is this animal expected to eat each day when expressed on as fed basis? What is the energy (TDN) and digestible crude protein (dCP) concentrations in the natural grass when expressed on as fed basis? How much milk per day is this animal expected to produce by consuming the allocated natural grass? The nutrient requirements for the cow are as tabulated in **Table 4 (12 Marks).**

Table 4: Nutrient requirements for maintenance and milk production in dairy caws

Maintenance requirements per day			Milk production requirements per litre		
Weight (kg)	**TDN (g)**	**dCP (g)**	**Butter fat (%)**	**TDN (g)**	**dCP (g)**
350	3400	270	3.5	415	51
400	3700	290	4.0	470	56
450	4300	310	4.5	530	63

B). Using the deviation method, formulate a 130 g/kg protein concentrate mixture using Maize bran, Wheat brain and full fat soya. The concentrate mixture should also have 1% Limestone, 1% Di-calcium Phosphate, 0.5% Salt and 0.5% Micro mineral and Vitamin premix. What are the energy, calcium and phosphorus contents in the concentrate mixture? How much of this mixture is the animal in Question 6A supposed to eat for it to increase milk production to 8 litres per day? The nutrient content for ingredients required for concentrate mixture are given in **Table 5 (8 Marks).**

Table 5: Nutrient composition of feed ingredients for the dairy concentrate

Ingredient	**TDN (g/kg)**	**dCP (g/kg)**	**Calcium (%)**	**Phosphorus (%)**
Maize bran	810	84	0.3	0.25
Wheat bran	785	104	0.4	0.35
Full fat soya	855	284	0.5	0.65
Limestone	0.0	0.0	38	0.0
Di-calcium Phosphate	0.0	0.0	24.0	16.0
Vitamin/mineral premix	0.0	0.0	0.0	0.0

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

AGE 5241: PRINCIPLES OF FARM MANAGEMENT

2018/2019 DEFFERED EXAMINATIONS

INSTRUCTIONS:

ANSWER **ALL** FIVE (5) QUESTIONS

TIME: THREE (3) HOURS

Question one

a. What forces have caused farms to become larger in the 21st century **(8 marks)**

b. Explain the purpose and use of records in farm management **(12 marks)**

Question two

Contrast the following terms:

a. Complimentary and supplementary enterprises **(4 marks)**

b. Accounts payable and accounts receivable **(4 marks)**

c. Credit and debit **(4 marks)**

d. Cash accounting and accrual basis accounting **(4 marks)**

e. Average physical product and marginal physical product **(2 marks)**

f. Enterprise budget and whole farm budget **(2 marks)**

Question three

a. A new machine worth K100,000 has a useful life of 10 years. Use a 200% declining balance to compute annual depreciation for this , assuming a K10,000 salvage value. **(16 marks)**

b. A farmer has a debt to equity ratio of 2:1. The current liabilities are K50,000 and the non-current (intermediate and long-term) liabilities are K70,000. What is the value of the assets? **(4 marks)**

Question four

a) Why is the kwacha received today much more important than the same kwacha to be received at a future date? **(4 marks)**

b) What is the value of K60, 000 to be received ten years from today at 13% compound interest? **(4 marks)**

c) If land is currently worth K40, 000 per hectare in Lusaka west and is expected to increase in value at a rate of 4 % annually, what will it be worthy in 5 years. **(4 marks)**

d) What is the value of K500, 000 placed on a savings account at 20% interest rate for 5 years, compounded every three months? **(4 marks)**

e) What are the advantages of using the net present value over the pay pack period in investment analysis? **(4 marks)**

Question five

a. What is risk and how does it differ from uncertainty **(2 marks)**

b. In the past 10 years, maize prices per 50kg bag have been K45,000, K46,000, K46,700, K55,000, K60,000, K62,000, K65,000, K66,000, K75,000 and K150,000. compute the

i) average maize price **(2 marks)**

ii) variance **(4 marks)**

iii) coefficient of variation **(2 marks)**

c. The following table shows the decision for Mr. Nyambe to choose the number of broiler chickens to raise. Options available are raising, 3000, 4000 and 5000 birds. According to the ministry of Agriculture, there is an outbreak of a disease in the country that might affect mortality rates, and there is a 40 % that his business will be affected. Predicted income from each batch of birds under two disease incidences is as shown below.

Disease outcome	**Probability**	**Rare 3000 birds**	**Rare 4000 birds**	**Rare 5000 birds**
Disease	40%	K25,000	0	-K90,000
No disease	60%	K750,000	K1,000,000	K1,250,000

i. Set up a decision tree for this risky decision **(8 marks)**

ii. Based on the most likely outcome and also based on the maximum expected value, which strategy in each case would Mr. Nyambe choose and why? **(2 marks)**

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2018/2019 MID-YEAR DEFERRED FINAL EXAMINATIONS
AGE 5251: AGRICULTURAL PROJECT PLANNING AND APPRAISAL
TIME: THREE HOURS
INSTRUCTIONS:

i) Answer all questions
ii) Leave the discount tables in the examination hall

---

1. a) Explain why technical and economic aspects are important in project preparation and analysis (6 marks)
   b) Are projects and programmes one and the same thing? Explain. (4 marks)
   c) Discuss briefly the major stages of a project cycle. (10 marks)

2. a) What is the definition of a shadow price in economic analysis? (4 marks)
   b) Why are shadow prices important in economic analysis? (6 marks)
   c) Discuss briefly the relationship between shadow prices and opportunity cost (OC) as well as marginal value product (MVP). (10 marks)

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

Amounts in ZKW' 000				
Year	**Investment Outlay**	**Operation and maintenance**	**Production Cost**	**Gross Benefit**
1	550	0	0	0
2	500	0	0	0
3	450	0	0	0
4	300	0	0	0
5	200	0	0	0
6	0	30	50	880
7	0	30	60	940
8	0	30	70	1000
9	0	30	80	1060
10	0	30	80	1060

a) Compute the Net Benefit-Investment (N/K) ratio if the opportunity cost of capital is 20%. On the basis of the N/K you obtain, would you recommend the project as good investment? Explain why? (6 marks)
b) Compute the Internal Rate of Return (IRR). On the basis of the IRR you obtain and given 20% as the opportunity cost of capital, would you recommend the project as good investment? Explain why? (10 marks)
c) If a 2 year delay in project implementation reduces the net present value of the project's benefits to ZKW+6,000 whereas a 3 year delay reduces the net present value to ZKW-8,000, what is the magnitude (switching value) of the

project's delayed implementation before the net present value falls below unacceptable level? Explain your answer. (4 marks)

4. The following information is given for a centre pivot to be imported into the country: the c.i.f. price is US$120,000; the import levy is 5% of the c.i.f. price; the handling and clearing charges amount to K15, 000 and the transportation to the project site is K5,000. The official exchange rate (OER) is ZKW11.50 to US$1 and a foreign exchange premium of 20% is estimated.
   a) Calculate the economic import parity value at the farm gate or project boundary using the conversion factor approach. (8 marks)
   b) Calculate the economic import parity value at the farm gate or project boundary using the shadow exchange rate approach. (8 marks)
   c) Why is it important to allow for a foreign exchange premium when calculating the economic import parity value? (4 marks)

5. 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 (ZKW '000)	
Year	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	0	90	0	500	0
2	0	130	0	450	0
3	0	160	0	350	0
4	200	0	100	300	140
5	450	0	250	0	170
6	550	0	350	0	170
7	700	0	400	0	170
8	700	0	400	0	170
9	700	0	400	0	170
10	700	0	400	0	170

a) If the opportunity cost of capital is 20%, compute the domestic resource cost (DRC). If the official exchange rate (OER) is ZKW 11.50 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) Explain why it is important to estimate the DRC and for what type of projects it should be applied? (5 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2018/2019 MID-YEAR DEFERRED FINAL EXAMINATIONS
AGE 5251: AGRICULTURAL PROJECT PLANNING AND APPRAISAL
TIME: THREE HOURS
INSTRUCTIONS:

i) **Answer all questions**
ii) **Leave the discount tables in the examination hall**

---

1. a) Explain why technical and economic aspects are important in project preparation and analysis (6 marks)
   b) Are projects and programmes one and the same thing? Explain. (4 marks)
   c) Discuss briefly the major stages of a project cycle. (10 marks)

2. a) What is the definition of a shadow price in economic analysis? (4 marks)
   b) Why are shadow prices important in economic analysis? (6 marks)
   c) Discuss briefly the relationship between shadow prices and opportunity cost (OC) as well as marginal value product (MVP). (10 marks)

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

Amounts in ZKW' 000				
Year	**Investment Outlay**	**Operation and maintenance**	**Production Cost**	**Gross Benefit**
1	550	0	0	0
2	500	0	0	0
3	450	0	0	0
4	300	0	0	0
5	200	0	0	0
6	0	30	50	880
7	0	30	60	940
8	0	30	70	1000
9	0	30	80	1060
10	0	30	80	1060

a) Compute the Net Benefit-Investment (N/K) ratio if the opportunity cost of capital is 20%. On the basis of the N/K you obtain, would you recommend the project as good investment? Explain why? (6 marks)
b) Compute the Internal Rate of Return (IRR). On the basis of the IRR you obtain and given 20% as the opportunity cost of capital, would you recommend the project as good investment? Explain why? (10 marks)
c) If a 2 year delay in project implementation reduces the net present value of the project's benefits to ZKW+6,000 whereas a 3 year delay reduces the net present value to ZKW-8,000, what is the magnitude (switching value) of the

project's delayed implementation before the net present value falls below unacceptable level? Explain your answer. (4 marks)

4. The following information is given for a centre pivot to be imported into the country: the c.i.f. price is US$120,000; the import levy is 5% of the c.i.f. price; the handling and clearing charges amount to K15, 000 and the transportation to the project site is K5,000. The official exchange rate (OER) is ZKW11.50 to US$1 and a foreign exchange premium of 20% is estimated.
   a) Calculate the economic import parity value at the farm gate or project boundary using the conversion factor approach. (8 marks)
   b) Calculate the economic import parity value at the farm gate or project boundary using the shadow exchange rate approach. (8 marks)
   c) Why is it important to allow for a foreign exchange premium when calculating the economic import parity value? (4 marks)

5. 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 (ZKW '000)	
Year	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	0	90	0	500	0
2	0	130	0	450	0
3	0	160	0	350	0
4	200	0	100	300	140
5	450	0	250	0	170
6	550	0	350	0	170
7	700	0	400	0	170
8	700	0	400	0	170
9	700	0	400	0	170
10	700	0	400	0	170

a) If the opportunity cost of capital is 20%, compute the domestic resource cost (DRC). If the official exchange rate (OER) is ZKW 11.50 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) Explain why it is important to estimate the DRC and for what type of projects it should be applied? (5 marks)

END OF EXAMINATION

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

2018/19 ACADEMIC DEFERRED -YEAR EXAMINATIONS

AGF 2015
FUNDAMENTALS OF ORGANIC CHEMISTRY

Date: 9Th December, 2019
Time: 9:00 Hours – 12:00 Hours
Venue: Other rooms

Duration: THREE (3) HOURS

INSTRUCTIONS TO THE CANDIDATES

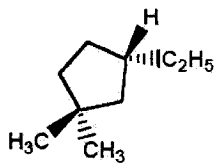
1. THIS PAPER CARRIES 100 MARKS.
2. WRITE YOUR COMPUTER NUMBER ON ALL ANSWER BOOKLETS
3. THERE FOUR QUESTIONS IN THIS PAPER.
4. **ATTEMPT ALL QUESTIONS**. EACH QUESTION CARRIES 25 MARKS.
5. ANSWER EACH QUESTION IN A SEPARATE ANSWER BOOKLET.
6. ALLOCATED MARKS FOR EACH QUESTION ARE INDICATED IN THE BRACKETS.

Question 1

a) Draw dash-wedge structures for all stereoisomers of 1-bromo-3-isopropylcyclohexane, giving stereochemical details for each structure.

[2 marks]

b) What is the complete IUPAC name of the following substance? (give stereo-chemical details such as R, S as relevant.)



[8 marks]

c) You have a sample (Sample X) which is a mixture of +/- Carvone. The solution was made by dissolving 4.50 g of the sample in enough methanol to bring the volume of solution to 10.0 mL. Some of the solution is placed in a 100 cm polarimeter cell and its optical rotation is measured at 25°C using light of the sodium D line wavelength (589.6 nm). The observed rotation is +22.2°.

I. What is the specific rotation of this sample?

[2 marks]

II. An enantiomerically pure sample of the (*S*) enantiomer of Carvone has a specific rotation of +15.5°. What is the % enantiomeric excess of Sample X.

[5 marks]

III. What percentage of Sample X is the (*S*) enantiomer? What percentage of the sample is the (*R*) enantiomer?

[8 marks]

Question 2

Propene, C_3H_6, a hydrocarbon reacts with chlorine, Cl_2, in a reaction that is given below.

$$C_3H_6 + Cl_2 \rightarrow C_3H_6Cl_2$$

The mechanism for this reaction is described in three stages.

a) Define the term hydrocarbon.

[2 mark]

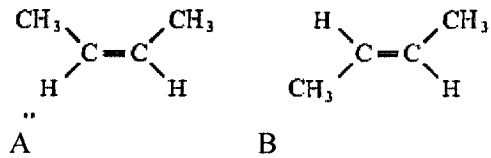
b) Name the three stages of the mechanism of this reaction

[6 marks]

c) For each stage named in (b) draw the mechanism of the reaction.

[6 marks]

d) The drawing below represents two alkenes, A and B.



A B

i. What is the difference between compound A and B.

[2 marks]

ii. Name compound A and B.

[2 marks]

e) Name one ether that you know and draw its chemical structure

[3 marks]

f) Write the reaction of methylamine with hydrochloric acid.

[4 marks]

Question 3

2-chloro-2-methylbutane may be prepared by reacting 2-methylbutan-2-ol with concentrated hydrochloric acid:

$$(CH_3)_2C(OH)CH_2CH_3 + HCl \rightarrow (CH_3)_2C(Cl)CH_2CH_3 + H_2O$$

a) Draw the skeletal formula of 2-chloro-2-methylbutane. **[2 marks]**

b) What type of reaction is this? **[1 mark]**

c) Write the mechanism of this reaction, showing the arrows indicating the flow of electrons. **[5 marks]**

d) Explain briefly how you may purify the product produced in this reaction. **[11 marks]**

e) The side reaction to above reaction may produce an alkene.

i. Name the alkene produced. **[1 mark]**

ii. Write the mechanism for this reaction? **[5 marks]**

Question 4

4-hydroxybutanoic acid is a naturally occurring substance found in the human central nervous system, as well as in wine, beef and citrus fruits. 4-hydroxybutanoic acid is a sticky solid with a melting temperature of 48–50°C.

a) About 5 g of 4-hydroxybutanoic acid was placed in a test tube and melted by heating in a hot water bath. A small piece of sodium was added to the molten 4-hydroxybutanoic acid.

I. Draw the displayed formula of 4-hydroxybutanoic acid. **[3 marks]**

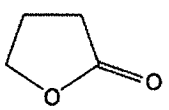
II. How many functional groups are present in this acid and name these functional groups. **[4 marks]**

b) A spatula full of 4-hydroxybutanoic acid was added to a solution of sodium hydrogencarbonate in a test tube. Vigorous effervescence was observed.

I. What is effervescence? **[1 mark]**

II. State the test that you would use to confirm the identity of the gas formed. Give the result of the test. **[5 marks]**

c) 4-hydroxybutanoic acid reacts on heating in the presence of a catalyst to form 4-butyrolactone which is used in food flavouring, and as a superglue remover. The structure of 4-butyrolactone is given below.



4-butyrolactone

I. By considering the functional group present in 4-butyrolactone, name the type of reaction which occurs when 4-hydroxybutanoic acid forms 4-butyrolactone. **[2 marks]**

II. Why is a suitable catalyst added to this reaction? **[2 marks]**

a) Acetic acid has pka equal to 4.8.

III. Calculate the ka of acetic acid? **[4 marks]**

IV. What would be the effect on ka of acetic acid by a chloride atom placed at the alpha position of acetic acid. Explain your answer. **[4 marks]**

END OF EXAMINATION

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

2018/19 ACADEMIC YEAR DEFERRED EXAMINATIONS

AGF 3021
Chemical Techniques in Food Analysis –Theory Exam

Date: 9Th December, 2019
Time: 14:00 Hours – 17:00 Hours
Venue: Sports Hall

DURATION: THREE (3) HOURS

INSTRUCTIONS TO THE CANDIDATES

1. THIS PAPER CARRIES 100 MARKS AND HAS **TWO (2) SECTIONS.**
2. EACH QUESTION CARRIES **25 MARKS.**
3. THERE ARE FIVE (5) QUESTIONS IN THIS PAPER. ANSWER **FOUR (4)** QUESTIONS. SECTION B IS COMPULSORY.
4. **ANSWER EACH SECTION IN A SEPARATE ANSWER BOOKLET.**
5. ALLOCATED MARKS FOR EACH QUESTION ARE INDICATED IN THE BRACKETS.

SECTION A: [ANSWER ANY THREE (3) QUESTIONS FROM THIS SECTION]

QUESTION 1

a) In not more than five (5) lines, define and explain the following terms giving examples where necessary.
i. Semi qualitative **[2 Marks]**
ii. Representative sample **[2 Mark]**
iii. Accuracy **[2 Marks]**
iv. Limit of Detection **[2 Marks]**
v. Non-destructive analyses **[2 Marks]**

b) Briefly define reliability and state its importance in analytical chemistry. Additionally, why is the reliability of the representative sample very critical? Furthermore, briefly discuss the relationship between reliability and the analytical method. **[7 Marks]**

c) As a trained Laboratory Analyst, explain the underlying principles of the technique that can be used to determine the ether extract of dried soybean flakes. **[8 Marks]**

QUESTION 2

Sampling and sample preparation are among the steps involved in an analytical process. As a newly appointed Food Analyst in the Chemistry Laboratory, a client brought to you a 100 Kg bag of Sunflower for Metabolizable Energy and Mineral Content determination. Discuss in detail how you would approach this task. **[25 Marks]**

QUESTION 3

a) The department of Food Science and Nutrition has bought two (2) sets of equipment, that is, an analytical weighing balance and a pH meter. During a laboratory session, the Chief Technician in the Food Chemistry Laboratory realizes that these sets of equipment are not properly calibrated. As a student in this department, briefly discuss how you can calibrate this equipment. **[5 Marks]**

b) List the three (3) main steps involved in a gravimetric analysis, and define a gravimetric factor (GF). **[4 Marks]**

c) An ore is analyzed for the manganese (Mn) content by converting the manganese to Mn_3O_4 and weighing it. If a 1.52 g sample yields Mn_3O_4 weighing 0.126 g, what would be:

   i. The percent Mn_2O_3 in the sample? **[4 Marks]**

   ii. The percent Mn in the sample? **[4 Marks]**

d) How many grams of copper (II) sulfate hexahydrate are required to prepare a solution that has the equivalent of 0.339 g of copper dissolved? What is the percentage composition of sulphur in the solution? **[8 Marks]**

QUESTION 4

In the food industry, various methods of food sample size reduction are employed. Discuss the principles of operation of using illustrations where necessary:

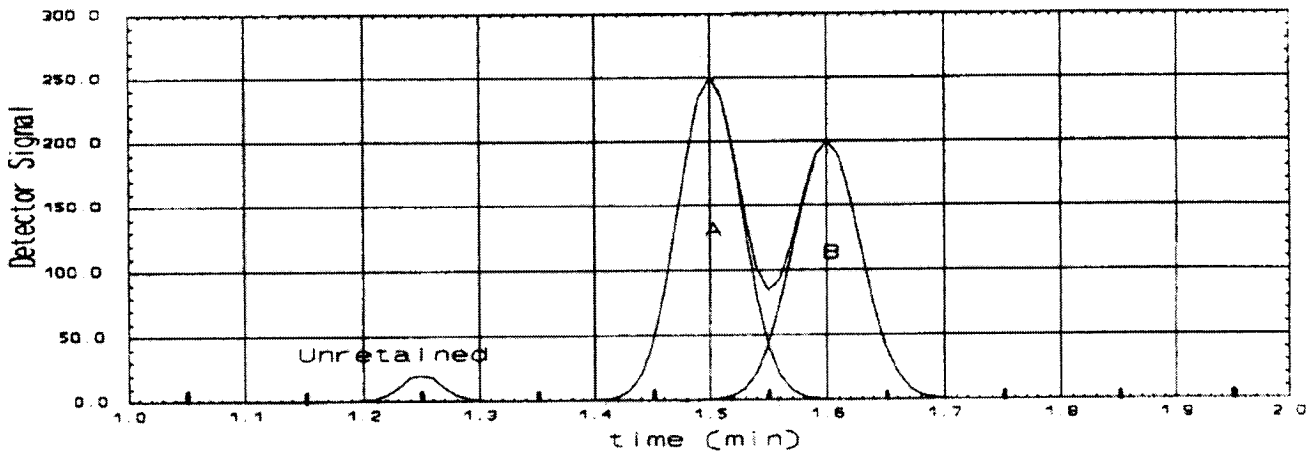
i. Rotary Rifle **[12.5 Marks]**

ii. Rotating Tube Divider **[12.5 Marks]**

SECTION B: [QUESTION 5 IS COMPULSORY]

QUESTION 5

a) The figure below shows a portion of a GC chromatogram for a mixture of two aromatic compounds labelled A and B. The separation employed a 2.20 meters packed column under isothermal conditions (90 °C) and a flow rate of 12 mL/min. The figure shows the chromatogram in the region between 1.00 and 2.00 minutes, with the chromatograms expected for the individual components being overlaid.



Explain how you would improve the capacity factor? Be specific using the parameters of this separation. **[2 Marks]**

Calculate the capacity factors for each peak and the selectivity factor for the separation of A and B. **[3 Marks]**

b) Calculate the resolution of the two peaks. **[5 Marks]**

c) Compare Adsorption and Partition (Normal – Reverse Phase) Chromatography. **[5 Marks]**

d) Heptane and toluene were separated with retention times of 15.4 and 16.5 min respectively on a 1.0-meter packed column. An unretained species passed through the column in 1.8 min. The peak widths measured at the base were 1.15 for heptane and 1.20 min for toluene.

i. Calculate the resolution between the peaks. **[5 Marks]**
ii. Calculate the average number of plates for the column. **[5 Marks]**

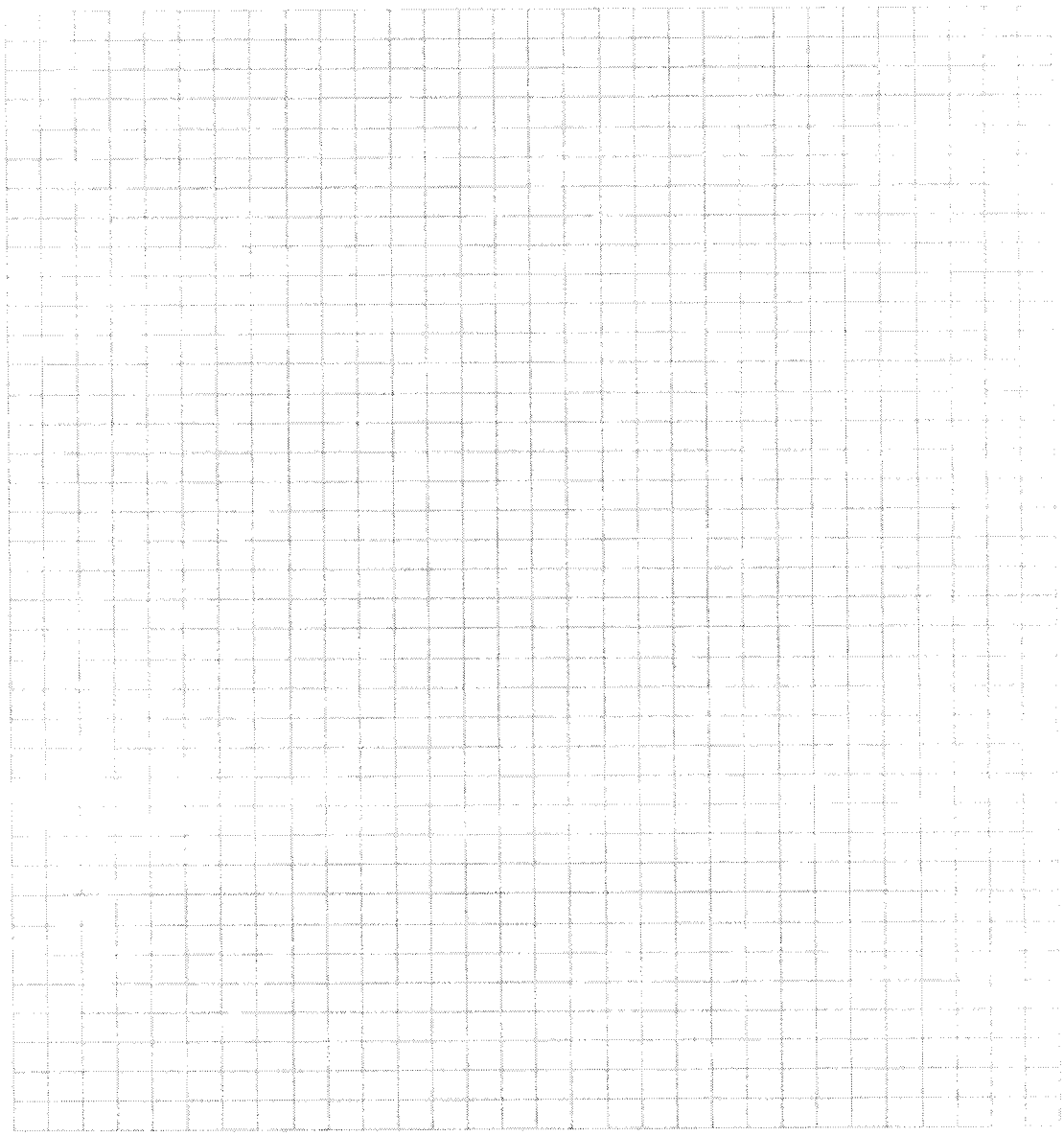
END OF EXAMINATION

UNIVERSITY OF ZAMBIA

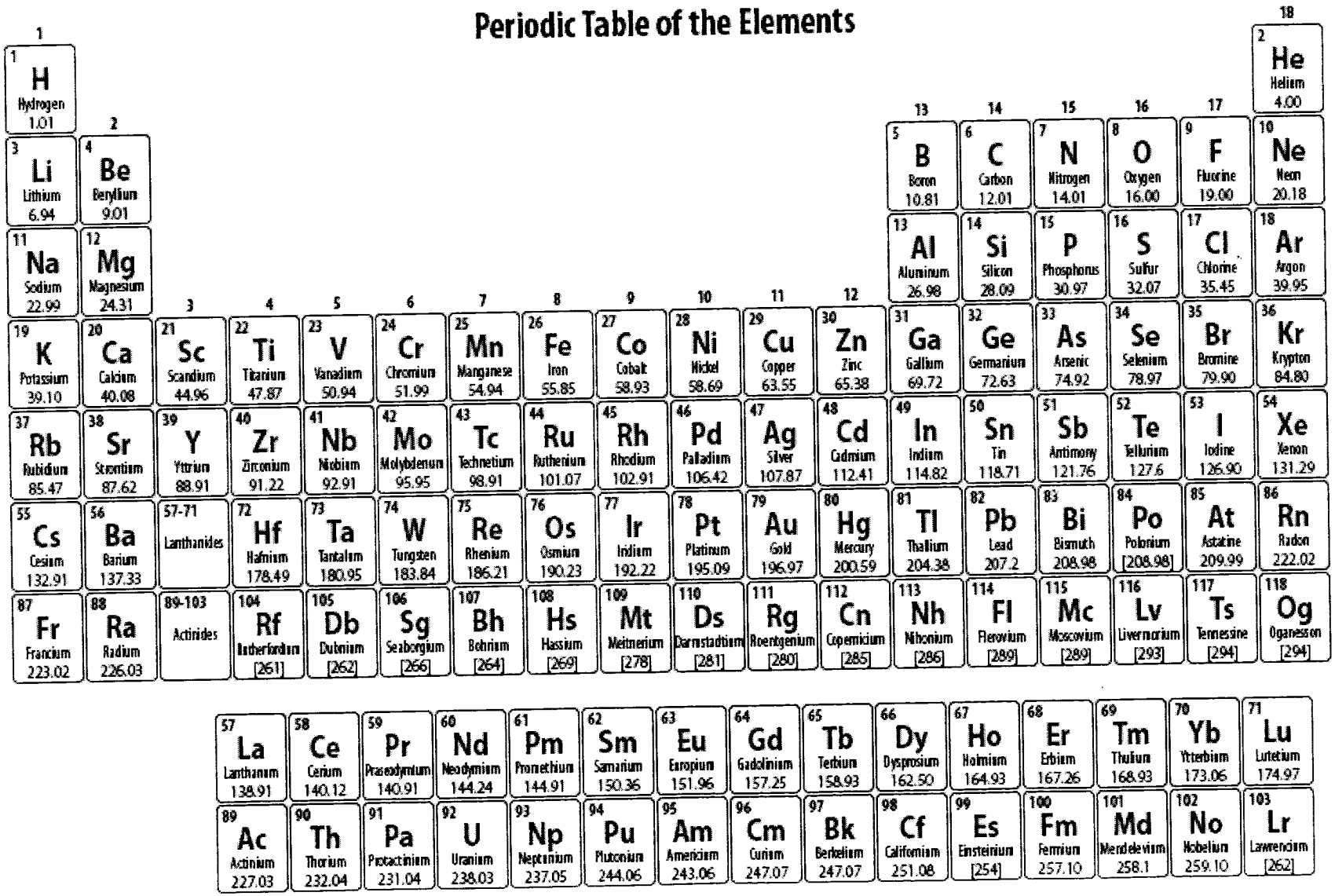
SCHOOL OF AGRICULTURAL SCIENCES

AGF 3021 DEFERRED EXAM FOR 2018/19 ACADEMIC YEAR

Student Computer#..... **Graph paper for question.....**



Periodic Table of the Elements



THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES AGRICULTURAL

DEPARTMENT OF ECONOMICS & EXTENSION

2018/2019 ACADEMIC YEAR DEFERRED EXAMINATION

AGG 3811: RURAL SOCIOLOGY

DATE: **11/12/2019** **TOTAL MARKS:** **100**

TIME: **THREE HOURS**

INSTRUCTION: ANSWER ALL QUESTION. EACH QUESTION CARRIES EQUAL MARKS

Questions

1. As ranked authority structure a bureaucratic organisation operates according to specific rules and procedures.
   a) Define the concept bureaucracy and organisation (8 marks)
   b) Using Max Weber's model explain any four major characteristics of bureaucracy (12 marks)

2. Outline and fully describe the five most common known forms of social interaction some of which help stabilize the social structure (20 marks).

3. "A family is both a primary group and a basic universal institution"
   a) Define the term institution
   b) Explain **three** major functions of the family
   c) State at least **two** known cultural threats that current environment pose on the Zambian families

4. Emile Durkheim and Karl Marx present two perspective on the discussion of social stratification.
   a) Identify and provide the meaning of each one of Karl Mark's and Emile Durkheim's perspectives.
   b) Briefly illustrate the differences between Karl Marx's and Emile Durkheim's views on social stratification.

5. Using a gender perspective mention any four major agricultural development issues that are selective and encourages gender inequalities in Zambia's rural agricultural development programmes (20 marks).

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

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES AGRICULTURAL

DEPARTMENT OF ECONOMICS & EXTENSION

2018/2019 ACADEMIC YEAR DEFERRED EXAMINATION

AGG 3822: AGRICULTURAL EXTENSION EDUCATION

DATE: **12/12/2019** **TOTAL MARKS:** **100**

TIME: **THREE (3) HOURS**

INSTRUCTIONS: **ANSWER ALL QUESTIONS**

Questions

1. Briefly discuss the theoretical importance of objectives, target groups, offering and organization elements in the design of an extension delivery system (20 marks)

2. "Extension methods are commonly classified into individual, group and mass media".
   a) Define the concept extension methods (4 marks)
   b) State the four major differences between group and mass extension methods (12 marks)
   c) Explain the suitability of result demonstration, lecture, and tour and learn extension methods to learning situations (6 marks).

3. In a chronological order, outline and describe the five management functions that helps in the design and operational efficiency of an extension organization (20 marks).

4. With known practical examples provide meaning to the following concepts:
   a) Farming Systems Research (5 marks)
   b) Communication (5 marks)
   c) Unity of command (5 marks)
   d) informal organization (5 marks)

5. Based on identified and explained "ideal types" adopter categories, indicate their usefulness in the diffusion process (20 marks).

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

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2018/2019 END OF YEAR FINAL EXAMINATIONS

COURSE : AGG 3832 - FORAGE CROP PRODUCTION AND RANGE MANAGEMENT
DATE :FRIDAY, 15 NOVEMBER 2019. 14:00 HOURS
DURATION : 3 HOURS
INSTRUCTIONS : ANSWER ANY FIVE QUESTIONS

---

1. a) Define an ecosystem (3 marks).
   b) What are the components of an ecosystem in rangelands? (6 marks).
   c) Draw a diagram to show energy flow in an ecosystem (6 marks).
   d) What are ecosystem goods and services? Explain and give examples (5 marks).

2. In range management it is important to carry out natural resource inventory in order to obtain dimensional or physiological information about the resources.

   a) In natural resource inventory mention the six types of plant attributes that are commonly measured. (6 marks).
   b) What is a quadrat? How is it used in vegetation assessment.? (5 marks).
   c) How does the size of a quadrat affect the results in vegetation assessment? (4 marks).
   d) What size of quadrat would you recommend when measuring the frequency and the density of moringa (*Moringa oleifera)* and Leucaena (*Leucaena leucocephala*) in a rangeland (5 marks).

3. Rangelands have been neglected for a long time in programmes concerning agricultural development although they are very importance as sources of livelihoods for the local people?

   a) What are the characteristics of range lands? (4 marks)
   b) Mention products of economic importance that can be derived from rangelands (6 marks).
   c) What are the causes of land degradation in these rangelands? (4 marks).
   d) What management practices should be carried out to conserve and improve the productivity of the rangelands? (6 marks).

4. Pasture grasses and legumes are an importance component of the ecosystem in grazing lands.

   a) Give examples of any three pasture grasses and two pasture legumes. Please indicate their scientific names as well. (5 marks).
   b) Mention and explain five differences between pasture grasses and legumes (10 marks).
   c) What are the benefits of having grass/legumes mixture in grazing lands compared to pure grass or pure legume stands? (5 marks).

5. During one of the forage crop production lessons a student was asked to define rotational grazing and he said that rotational grazing is a kind of grazing where the animal rotates while it is grazing. The other students upon hearing this laughed a lot.

   a) From your understanding of rotational grazing would you agree or disagree with this definition? Give an explanation for your answer (5 marks).
   b) What are the benefits of rotational grazing (4 marks).
   c) What are the factors that affect grazing time (6 marks).
   d) Determine the number of 280kg heifers a 80-hectare pasture will support for 100 days, given a pasture yield of 2,000kg of dry matter per hectare. Take Dry matter intake of the animals to be 3% of their body weight. (5 marks).

6. You have been giving a series of talks to cattle farmers in Chisamba concerning feeding their animals. Last time you discussed how to conserve forage through making of Hay and silage. For the next lesson indicate what you would tell the farmers as regards the following questions they asked last time.

   a) What are the characteristics of good quality hay (9 marks).
   b) How should hay be enhanced to improve its feeding value before giving it to animals (4 marks).
   c) What are the characteristics of good quality silage (7 marks).

THE END

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

Human Anatomy and Physiology, (AGN 2110) Examination

INSTRUCTIONS: Answer all Questions (100 marks) Time: 3 hr Date: 27th Nov, 2019

Question 1

a) In detail describe the functions of blood **(7 Marks)**

b) Describe blood flow through the kidneys from the renal artery to the renal vein **(6.5 Marks)**

c) Compare and contrast fetal blood circulation and post natal blood circulation **(6.5 Marks)**

Question 2

a) Outline the organization of the nervous system **(5 Marks)**

b) State the lobes of the cerebral cortex and the functions of each lobe **(10 Marks)**

c) State the primary functions of the digestive system. **(5 Marks)**

Question 3

a) In detail describe the transportation of oxygen (from the lungs to tissues) and carbon dioxide (from tissues to the lungs) in the body, keeping in mind that carbon dioxide has two transport systems. **(16 Marks)**

b) Describe the pathophysiology of atherosclerosis **(12 Marks)**

c) Describe the knee jerk reflex **(10 Marks)**

d) Describe the duodeno-hormonal regulation of stomach emptying **(10 Marks)**

e) In detail, describe the hormonal control of the ovarian cycle **(12 Marks)**

.....Good luck.....

UNIVERSITY OF ZAMBIA

END OF YEAR EXAMINATIONS, NOVEMBER 2019
AGS 2110
FUNDAMENTALS OF SOIL SCIENCE

TIME: 3 HOURS MARKS: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS

---

1. Define the following terms: (12.5 marks)

    a. Hardness of a mineral
    b. Liming material
    c. The grade of soil structure
    d. Physical weathering
    e. The void ratio of a soil (e)
    f. Sodic soil
    g. Mineralization
    h. Heterotroph
    i. Active acidity
    j. Permanent wilting point

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

    a. Kaolinite is a sheet silicate or phyllosilicate
    b. Dokuchaiev was a South African Scientist who pioneered the field of Pedology
    c. A mineral soil with a dry bulk density of 1.3 g/cm^3 and particle density of 2.65 g/cm^3 cannot have a volumetric moisture content of 55 %.
    d. Silt particles settle out of an aqueous soil suspension faster than sand particles.
    e. Sandstones are metamorphic rocks.
    f. Soils in which the largest pores filled with water have a diameter of 30 μm are wet.
    g. Sodic soils dominated by humus in their clay fraction will disperse more easily than sodic soils dominated by kaolinite.
    h. Muscovite forms earlier than olivine in magma as it cools to form igneous rocks
    i. A soil with a MWD_{dry} of 5.4 mm and MWD_{wet} of 3.5 mm has unstable aggregates.
    j. A soil containing 1.36 % organic matter and 500 mg N/kg soil will mineralize N when the organic matter decomposes.

3 Answer the following questions, briefly but concisely: (25 marks)

a. Most upland soils are derived from parent materials that originate from the weathering of rocks. Answer the following question:

i. List and define the three major classes of rocks that occur on earth based on their mode of formation. (4 marks)

ii. Write the chemical formulas for (i) kaolinite (ii) calcite (iii) gypsum and (iv) gibbsite; indicate the chemical class of minerals they belong to and whether they are primary or secondary minerals. (4 marks)

iii. Write a balanced reaction for the weathering of kaolinite to gibbsite by hydrolysis (3 marks)

b. A soil has a profile with the following horizons: C, Bhs, A, E, Oa, and R.
Answer the following:

i. Draw a soil profile indicating the right order in which these horizons would occur from the topmost to the deepest horizon. (2.0 marks)

ii. Indicate the solum and the soil in the profile. (2.0 marks)

iii. List and define the four major classes of soil forming processes. (4.0 marks)

c. Plants require nutrients to successfully complete their life- cycle. Answer the following (i) List any 10 nutrients that plants obtain from the soil, (ii) classify them based on plant nutritional requirements and (iii) indicate their bioavailable forms. (6.0 marks)

4. A soil obtained from a 20 cm deep A_P horizon using a cylindrical core ring with internal diameter of 5 cm and a height of 5 cm, had a moist mass of 180 g and an oven dry mass of 155g. If the particle density of the soil is 2650 kg/m^3, a field capacity of 35 % by volume and a permanent wilting point of 13 % by volume answer the following: (25 marks)

(i) Calculate the dry bulk density in g/m^3. (2. 5 marks)

(ii) Calculate the volumetric moisture content of this soil. (2.5 marks)

(iii) What is the volume of plant available water in litres per hectare of this soil? (2.5 marks)

(iv) How many millimeters of rainfall are required to wet this soil horizon? (2. 5 marks)

(v) If the whole horizon is at field capacity, calculate the total hydraulic heads at the top and at the bottom of the AP horizon in cm, and indicate the direction of water flow between the soil surface and the bottom of the AP horizon, assuming the soil surface is the reference level. (7.5 marks)

(vi) How many mm of water will flow out of the AP horizon in one day under the conditions described in question 4 (v) if the hydraulic conductivity of the soil is 7.5 x 10^{-6} cm/s. (5 marks)

(vii) How long will it take (in days) for the whole horizon to attain permanent wilting point if was initially at field capacity and lost water by evapotranspiration at the rate of 4.0 mm/ day? (2.5 marks)

5. Table 1 shows selected properties of the A horizon of a farmers' field

Depth	pH	ρ_b	P	Ca^{2+}	Mg^{2+}	Na^+	K^+	Al^{3+}	H^+	Total N	Org C
cm	0.01MCa Cl_2	g/cm^3	mg/kg	cmol/kg						%	%
0 -20	4.22	1.3	6.3	5.17	1.00	0.08	0.12	0.06	0.14	0.05	0.68

Answer the following: (27.5 marks)

a. What is the agronomic interpretation of the pH of this soil? [2.5 marks]

b. Calculate the ECEC of this soil. [2.5 marks]

c. Is nitrogen likely to be mineralized from the decomposition of organic matter in this soil? Give reasons to support your answer. [2.5 marks]

d. Supposing a farmer wants to grow a crop that requires 100 kg N/ha, 25 kg P/ha and 120 kg K/ha per season;

i. Would this soil meet the crops' seasonal requirement for N, P and K assuming that only 5 % of total N is mineralized per season and <u>all</u> the available P and K can be taken up by the crop in one season? Show calculations to support your answer. [7.5 marks]

ii. How many 50 kg bags of Compound D fertilizer, (10:20:10) would be required per hectare to meet the shortfall of P from the soil for the above crop? [5 marks]

iii. What method of fertilizer application would you recommend to the farmer to use in order to maximise the benefits from the fertilizer applied? Give reasons to support your answer. [2.5 marks]

e. If the total acidity of soil is 1.05 meq/100 g, how many 50 kg bags of lime with an ENV of 70 % are required to neutralize the total acidity in a Lima (0.25 ha) of this soil horizon? [5 marks]

Useful data:

Molar masses: Ca=40g, K=39 g, Mg=24g, Na=23g, P=31g, N=14g, H=1g, Al= 27g

R= 8.3145 J.mol^{-1}.k^{-1}, K = 273.15 + ° C, M_w = 0.018 kg.mol^{-1}

END OF EXAMINATION

SOIL SCIENCE IS FUN

THE UNIVERSITY OF ZAMBIA

HME 3522 QUANTITY FOOD MANAGEMENT AND FOOD SERVICE EXAM.

EXAMINER: MRS.N.C.MBEWE

DATE: 6TH NOVEMBER

TIME ALLOWED: 3 HOURS

INSTRUCTIONS TO CANDIDATE:

1. Ensure that your student number is clearly written on each answer booklet you use.
2. Ensure that the numbers of questions attempted are entered in spaces provided on the front of the answer booklet used.
3. **Answer all questions.**

QUESTION 1

a) Briefly discuss on the commercial and non-commercial segments of the food industry (10 marks).
b) Discus the positive and negative societal trends that affect the food service industry (10 marks).

QUESTION 2

Organizations are in continuous interaction with the environment and they are referred to as open systems.

a) **Draw** the basic structure of an open system and state the specific functions of the major parts .(**11 marks**)
b) The expanded system model of organization includes three additional parts; **list** and **describe** the function of each part (**9 marks**).

QUESTION 3

a) **Describe** the kind of managers that would be needed in the 21st century (**8 marks**).
b) **State** the three (3) areas of managerial effectiveness and four ineffective Management practices (**12 marks**).

QUESTION 4

(a) **State** five (5) factors to be considered in menu planning **(5 marks)**
(b) What are the principles of good menu planning? **(5 marks).**
(c)**Describe** the three (3) basic menu types **(6 marks).**
(d) How is wording on the menu card done **(4 marks).**

QUESTION 5

a) Identify three objectives of quality control in food industry? **(3 marks).**
b) **State** 4 factors in which quality of food prepared would depend on **(4 marks).**
c) Identify any six (6) areas that should be emphasized when training the employees on food safety. **(12 marks).**
d) What do the letters HACCP stand for in food safety? **(1 mark).**

QUESTION 6

(a) What do you look for when inspecting food establishment? (10 marks)
(b) **State** 4 methods you would use to improve productivity (3 marks).
(c) Write 7 principles of HACCP (7 marks).

QUESTION 7

a) What is procurement in food production?
b) State four (4) things that are involved in food procurement.
c) Identify ten (10) factors that are considered in food procurement.
d) State the mandatory information on a food package.

THE UNIVERSITY OF ZAMBIA

UNIVERSITY DEFERRED EXAMINATIONS – DECEMBER 2019

AGA 4311

Priciples of Genetics

Time allowed: Three (3) Hours Marks: 100

INSTRUCTIONS TO CANDIDATES:

a. Answer any **five (5)** questions.
b. All Questions carry equal marks (20).

Q. 1 Outline the structure of Deoxyribonucleic Acid (DNA) in relation to its function as a carrier of genetic information. How is this information translated to the sequence of amino acids in proteins?

Q. 2 a. Assume that in monkeys the three pairs of alleles +/r, +/s and +/t are a linkage group. As shown by the symbols, each mutant allele is recessive to its wild type allele. A cross between females heterozygous at the three loci and the wild type males gives the following results:

+ s +	436
r + t	427
r s t	38
+ + +	30
r s +	31
+ + t	36
+ s t	0
r + +	2

i. Are these genes linked? Justify your answer.
ii. What is the correct order of the genes?
iii. What are the genotypes of the flies involved in the parental cross and the test cross?
iv. What is the map distance between the genes?
v. Calculate the Coefficient of Coincidence and the Defree of Inteference.

b. Given that the genes R, S and T are linkage group with 15% recombination between R and S, and 25% recombination between S and T; and that the Coefficient of Coincidence is 0.7, what are the expected frequency of phenotypes from a test cross whose progeny are 1000?

Q. 3 a. Explain the sequence of events that take place during Prophase I of Meiosis and indicate their genetic consequences.

b. Given that the genes A, B and C are linkage group with 15% recombination between A and B, and 30% recombination between B and C; and that the Coefficient of Coincidence is 0.5, what are the expected frequency of phenotypes from a test cross whose progeny are 10, 000?

Q. 4 With the aid of clear examples, write detailed notes on mutagenic agents.

Q. 5 With the aid of clear examples, explain what is meant by each of the following on the following:

a. Point mutations;

b. A test cross and its use;

c. Sex determination and linkage;

d. Multiple alleles and co-dominance; and

e. Complementary as opposed to duplicate gene action.

Q. 6 a. Explain how the concepts of mutation and migration would offset the law of Hardy-Weinberg equilibrium in a large random-mating population.

b. Define gene frequencies and genotype frequencies and explain why they are important in the study of population genetics.

c. As a geneticist, would you say the goal of selection is to increase favorable genes? Briefly explain your views.

d. Describe assortative and disassortative mating. How does disassortative mating affect the frequency of heterozygotes in a population?

End of Examination

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

DEFERRED EXAMINATIONS—2018/19 ACADEMIC YEAR

COURSE NAME:	INTERNATIONAL AGRICULTURAL MARKETS, TRADE AND DEVELOPMENT
COURSE CODE:	AGE 5151
DATE:	FRIDAY, 13TH DECEMBER, 2019
TIME:	09:00 – 12:00
TOTAL MARKS:	100

INSTRUCTIONS:

1. This examination paper has two sections. Section A has five (5) questions and Section B has two (2) questions.
2. Read all the questions carefully and answer all questions from both sections.
3. Points for each question are shown in parenthesis. Therefore, allocate your time appropriately.
4. Please be concise but thorough when answering the questions.

SECTION A

1. Adam Smith is well known for having developed the theory of absolute advantage. Using an example in agricultural trade, give a detailed explanation of this theory. **(10 marks)**

2. Discuss four (4) realistic characteristics of production that are incorporated in the factor proportions model but are left out of the simple Ricardian model. **(10 marks)**

3. With the aid a partial equilibrium diagram, state and briefly explain the effect of a small country removing an import quota on the following economic measures in the country: (i) price of wheat (ii) consumer and producer welfare (iii) government revenue (iv) national welfare. **(10 marks)**

4. Describe trade creation using the COMESA customs union as an example. Your answer should clearly outline the key assumptions for analyzing trade creation and should also include a graphical illustration. **(10 marks)**

5. What is the twin deficit identity and how does one interpret the identity? Draw a well-labelled circular flow diagram with the various components of the identity. **(10 marks)**

SECTION B

1. Use the information in the table below to answer this question.

	Cost of food basket	**Exchange Rate 17/06/2019**
Zambia	ZMW 5,000.00	--
Botswana	BWP 4,950.00	0.83 BWP/ZMW
South Africa	ZAR 4,500.00	1.13 ZAR/ZMW

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

a) Calculate the Zambian Kwacha cost of the basket in Botswana and the Zambian Kwacha cost of the basket in South Africa and explain if the law of one price holds in either case. **(8 marks)**

b) Is the Zambian Kwacha overvalued or undervalued with respect to the BWP and the ZAR? Show your work and explain. **(5 marks)**

c) Assuming zero transport cost and no trade restrictions exist between the two countries, explain how this scenario would affect the following: (1) supply of Kwacha on the Zambian FOREX; (2) demand for Kwacha on the Zambian FOREX; (3) ZAR/ZMW spot exchange rate, and; (4) final adjustment of the relevant parity condition. ***Ensure to provide graphical illustrations.*** **(12 marks)**

2. Suppose it requires 10 units of labour and 5 units of land to produce a ton of paprika while it requires 2 units of labour and 4 units of land to produce a ton of wheat. Suppose the price of paprika is $300/ton and the price of wheat is $100/ton.

   a) Derive the zero profit conditions for paprika and wheat and compute the equilibrium wage and rental rates. Show the equilibrium on the relevant graph. **(12 marks)**

   b) If the price of paprika rises to $350/ton, what would be the new equilibrium wage and rental rates? Draw a separate graph showing the old equilibrium and the shift to a new equilibrium. **(7 marks)**

   c) Based on the change in the price of paprika, compute the percentage changes in the price of paprika, price of wheat, wage rate and rental rate. Show the appropriate magnification effect relationship for prices for this case and interpret it. **(6 marks)**

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