

UNIVERSITY OF FORT HARE

SPECIAL EXAMINATIONS

JANUARY/FEBRUARY 2019

AGG 311

Subject: Farm Buildings

Time: 3 hours

Marks: 100

This paper consists of 6 pages including the cover page

Internal Examiner

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External Examiner

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Instructions

Use of non programmable calculators is permitted.

Make use of the data tables provided at the back of the question paper.

Tick which questions you answer on the front page of your answer sheet.

ANSWER all QUESTIONS

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1. A shed suitable for poultry is available. The shed is 8 m wide and 35 m long.
 - a. How many layers can be housed on deep litter in the shed? (8)
 - b. How many nest boxes will be required? (4)
 - c. How many tube feeders will be required? (4)
- d. If mortality of hens during the laying cycle is expected to be 8% and an average of 84% of hens lay an egg each day, calculate the average daily egg production. (6)

Table 1: Floor space requirements for poultry

Type of bird	Birds/m ²	Area (m ²) / bird
3---6 weeks, broilers on deep litter	10—12	0.1
6---18 weeks, pullets	7---8	
Layers on deep litter	5	0.2
Layers on wire floor	9	0.11
Battery cages for layers		0.04
1 nest per 5 layers. Nest size 250mm wide, 300mm deep, 300mm high.		
Communal nests, area per nest = .09m ²		
Layers: 9 tube feeders and 9 x 300mm diameter drinkers per 100 hens.		
Average no. Hens per batch = no. Pullets x $\left[\frac{100 - (\text{mortality}\%/2)}{100} \right]$		
Eggs/cycle = $\frac{\%egg \text{ prodn} \times \text{avg no. hens} \times \text{laying days/cycle}}{100} \left(\frac{\%egg}{\text{hen.day}} \right) (\text{hen}) \left(\frac{\text{day}}{\text{cyc}} \right)$		

2. Explain what is meant by an all in-all out management system for intensive livestock buildings. (8)
3. Why is labour requirement important when considering which type of dairy parlour should be used? (8)
4. Give two (2) reasons why dip tanks should be emptied and cleaned out every few years. (8)
5. An internal fence is required for an intensive large stock farm where the soil conditions are fairly soft. From the information given make recommendations about the specifications of the fence that should be used and calculate the main materials required to build 0.85 km of that fence. (12)

Table 1: Minimum wire strands required for stock fencing.

Fence type	Stock size	Number and type of wires required			
		Barbed only	Plain only	Mixed types of wires	
				Barbed	Plain
boundary	Mixed	6	7	4	2
	Large	5	5	Any combination total of 5	
	Small	5	5	Any combination total of 5	
Internal	Mixed	6		Any combination total of 6	
	Large	5		Any combination total of 5	

	Small	5		Any combination total of 5
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Table 2: Standards and droppers required for stock fencing.

Conditions	Stock type	Spacing between standards	Number of droppers between standards
Intensive stock Mainly soft soil Constant animal pressure	Only large or only small	12	2
	Mixed	12	3
Average	Only large or only small	16	3
	Mixed	16	4
Extensive farming Only occasional contact by animals .	Only large or small	20	4
	Mixed	20	5

6. A poultry house that is 11 m wide and 18 m long will need illumination in order to increase productivity. The preferred lamps will use 15 W energy saver bulbs. Calculate how many lamps will be required to provide sufficient light. (6)

Table 3: Light output of different types of lamps. (lumens/ lamp)

Incandescent		Energy savers		Fluorscent (strip)		
Watts	Lumens	Watts	Lumens	Watts	Length(mm)	Lumens
40	430	11	605	15	450	600
60	810	13	715	20	600	900
100	1 600	15	825	40	1200	2250
150	2 500	20	1100	60	1200	3250

Table 4: Lighting requirements Illumination (lux)

Animal houses		Farm buildings		Dwelling	
Animal	Illn.(lux)	Type	Illn.(lux)		Illn.(lux)
chickens	5-15	Dairy wash up	1000	Kitchen gen.	100
animal feeding	200	Bulk tanks	1000	Kitchen work ar.	350
Milk parlour	200	Barns, stores	40	Rooms gen.	75

Light output at source (lm) = Area of room(m²) x required illumination(Lux) x 2

7. A pig enterprise is planned for 140 breeding sows with an average of 2.483 farrowings per year and 10.7 piglets weaned per farrowing. Baconers will be produced with an average live mass of 85 kg at slaughter. Dressing percentage is 70%. Price expected for dressed carcasses is R21. 24/kg. Price expected for fresh manure is R329/ton. The expected average total number of pigs will be 1690 and the average mass will be 50 kg. The daily excretion of pigs is 7.2% of animal mass. The total cost of the buildings is estimated to be R3 500 000. Interest rates are 14%. The life expectancy of the buildings is 20 years. Decide if the income generated will justify the cost of the buildings. (16)

Mass of annual undiluted excretion

$$= \text{number of animals} \times \text{average body mass(kg)} \times \frac{\% \text{ daily excretion}}{100} \times \frac{365}{1000} \left(\frac{\text{ton}}{\text{yr}} \right)$$

Allowable annual expenditure on building

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$$= \frac{\text{annual gross income} \times \% \text{income that can be spent on facility (table 2)}}{100}$$

$$\text{Maximum investment in building} = \frac{\text{Allowable annual expenditure on building} \times 100}{\% \text{ annual ownership cost (table 1)}}$$

Table 5: Annual cost of ownership of a building as a percentage of initial capital cost.

	% of capital cost for different life spans of the building		
	40 years	20 years	10 years
Total annual cost as % of initial cost	3.56 + interest rate/2	7.06 + interest rate/2	12.56 + interest rate/2

Table 6: Percentage of gross annual income which should be available for paying the cost of ownership of a viable facility.

Building or facility type	% of gross annual income to spend on facility
Dairy	10
Beef	8.5
Pigs	10.5
Sheep	9
Poultry	10.5

8. Calculate the total materials required to construct the concrete foundations and floor of the 3 room house shown below. (20)

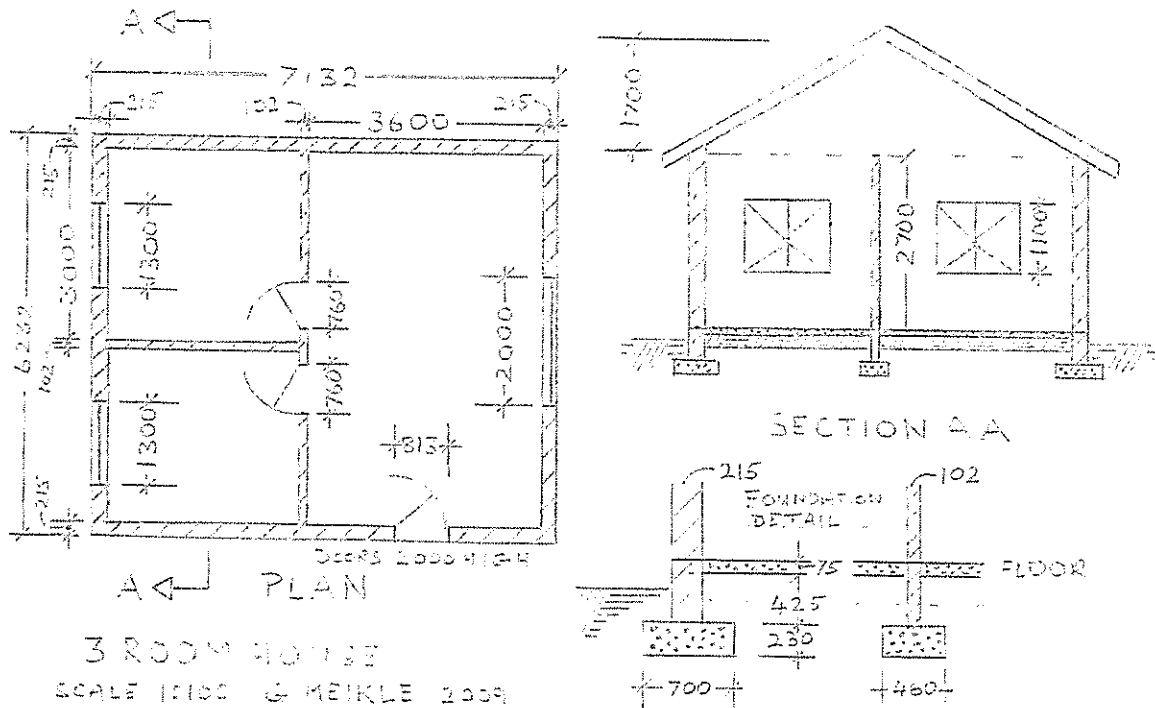


Table 7: Use of standard concrete mixes (applicable to table 7)

Kind of work	Mix number
General purpose lean mixture for foundations, weirs, thickness over 500mm.	D or E
General reinforced work on buildings, walls, pavements, light floors.	C
Important reinforced work, driveways, garage and workshop floors, heavy precast articles, septic tanks, reservoirs, gate posts.	A or B
Fencing posts, small precast articles, concrete less than 75mm thick, top layers of concrete floors	F or G

Table 8: Standard concrete mixes according to volume. (Hand compaction)

1 Mi x No.	Strength MPa	2 Ston e size (mm)	3 Material per bag of cement			4 Material per m ³ of concrete			5 Material for mixing in small batches		
			Sand (litre)	Ston e (litre)	Wate r (litre)	Cemen t (bags)	San d (m ³)	Ston e (m ³)	Cemen t (bags)	San d (m ³)	Ston e (m ³)
A	30	20	80	90	20	8.1	0.65	0.73	1	1.75	2
		40	80	120	20	7.4	0.59	0.89	1	1.75	2.75
B	25	20	90	100	22	7.2	0.65	0.72	1	2	2.25
		40	90	130	22	6.6	0.59	0.86	1	2	3
C	20	20	110	120	25	6.4	0.70	0.77	1	2.5	2.5
		40	110	150	25	5.8	0.64	0.86	1	2.5	3.5
D	15	20	140	140	30	5.5	0.77	0.77	1	3.25	3.25
		40	140	170	30	5.0	0.70	0.85	1	3.25	3.75
E	10	20	170	170	35	4.6	0.80	0.80	1	3.75	3.75
		40	170	200	35	4.2	0.71	0.84	1	3.75	4.25
F	30	10	90	60	19.5	9.1	0.81	0.54	1	2	1.33
G	20	10	120	70	25	7.2	0.86	0.54	1	2.66	1.5

Table 9: Bricks and mortar required per m² of wall with 10 mm mortar joints.

Size of brick or building block (mm)	Wall thickness	Number of bricks per m ² of wall	Volume of mortar (m ³) per m ² wall
215 x 102.5 x 65mm	102.5mm, half brick	60	0.018
215 x 102.5 x 65mm	215mm, one brick	120	0.043
M4 block 390Lx90Wx190H	90 mm hollow	12.5	0.012
M6 block 390Lx140Wx190H	140 mm hollow	12.5	0.020

Wastage: Concrete 10%
 Bricks and blocks 5 to 10%
 Mortar 15%
 Plaster 20%

Standard thickness of plaster 15 mm

Table 10: Uses of standard Mortar mixes (Applicable in table 11)

Type of work	Mix number
Fill below machine bases, drain pipe joints	a
Walls above roof level or below floor level, cavity walls load bearing 102mm walls, stone slate or concrete paving blocks.	b

Internal or external walls above floor level and below roof level.	c
Non load bearing internal walls.	d or e
Unimportant structures	f

Table 11: Standard mixes for mortars and plasters according to volume

1	2		3		4	
Mix number	Materials for standard batches		Materials per m ³ mortar		Materials for small batches	
	Cement (bags)	Sand (litres)	Cement (bags)	Sand (m ³)	Cement (tins)	Sand (tins)
a	1	100	11.6	1.15	1	2.25
b	1	150	8.5	1.27	1	3.5
c	1	200	6.7	1.34	1	4.5
d	1	250	5.5	1.38	1	5.75
e	1	300	4.7	1.41	1	6.75
f	1	350	4.1	1.41	1	8

END OF EXAMINATION

Answers

1.1 Area of house = length x width (8)

$$= 35 \times 8$$

$$= 280 \text{ m}$$

From table 1, layers/m² = 5layers/m²

Number of layers per house = layers/m² x area of house

$$= 5 \times 280$$

$$= 1\ 400 \text{ hens/hse}$$

1.2 From table 1, 1 nest box per 5 layers. (4)

Number of nest boxes for house = $\frac{\text{number of hens}}{\text{hens per nest box}}$

$$= \frac{1400}{5}$$

$$= 280 \text{ nest boxes}$$

1.3 From table 1 there should be 9 tube feeders per 100 hens. (4)

Number of tube feeders for house = $\frac{\text{tube feeders per 100 hens} \times \text{number of hens}}{100 \text{ hens}}$

$$= \frac{9 \times 1400}{100}$$

$$= 126 \text{ tube feeders.}$$

1.4 Average no. Hens per batch = no. Pullets x $\left[\frac{100 - (\text{mortality}\%/2)}{100} \right]$ (6)

$$= 1400 \times \left[\frac{100 - 4}{100} \right]$$

$$= 1400 \times 0.96$$

$$= 1\ 344 \text{ hens/batch}$$

Eggs/day = $\frac{\% \text{egg prodn} \times \text{avg no. hens} \times \text{laying days}}{0.100} \left(\frac{\% \text{egg}}{\text{hen-day}} \right) (\text{hen}) \left(\frac{\text{day}}{\text{cyc}} \right)$

$$= \frac{84 \times 1344 \times 1}{100}$$

$$= 1\ 129 \text{ eggs/day}$$

2. "all in-all out" is a system used to control the build up of pests and diseases. All birds or animals are introduced into a room or building together, and all are removed before the building is sanitised and then the next batch is introduced. (8)

3. Labour requirement is important when comparing different types of dairy parlour because milking is a very repetitive operation which needs to be done two or three times per day every day of the year. Milking must also be completed in a reasonably short time. The cost of labour is an important factor when considering viability of the enterprise. When the reliability of labour is a problem a parlour that requires a minimum work is easier for a skeleton work force to manage. (8)

4. (8)

- There is an accumulation of mud in the bottom of the tank which must be removed to prevent the larger cattle from being able to stand on the bottom which would prevent them from being treated with the dip on their heads.
- The type of dip chemical being used must be changed to prevent the development of resistant strains of ticks.

5. Fencing recommendations for an internal fence for large stock only is a total of 5 strands. These can be any combination of barbed and plain wire, but 4 lower strands of barbed wire and 1 top strand of plain wire is suggested. For intensive pressure of large stock only and soft soil the spacing between standards should be 12 m and there should be 2 droppers between standards.

Materials for 0.85 km fence.

$$\text{Length of fence} = 0.85 \text{ km} \left[\frac{1000\text{m}}{\text{km}} \right] = 850 \text{ m}$$

Length of barbed wire = length of fence x no. strands

$$= 850 \times 4$$

$$= 3400 \text{ m}$$

Length of plain wire = length of fence = 850 m

$$\text{Number of standards} = \frac{\text{length of fence}}{\text{space between standards}}$$

$$= \frac{850}{12}$$

$$= 71 \text{ standards}$$

Number of droppers = number of standards x no droppers between standards

$$= 71 \times 2$$

$$= 142 \text{ droppers} \quad \text{_____} \quad (12)$$

6. Area of poultry house = l x b

$$= 18 \times 11$$

$$= 198 \text{ m}^2$$

From table 3 level of illumination required for poultry is between 5 to 15 Lux. Use the average, 10 Lux.

Light output at source(lm) = Area of room(m²) x required illumination(Lux) x 2

$$= 198 \times 10 \times 2$$

$$= 3960 \text{ Lm}$$

Light output of 15 W energy saver lamps from table 5 is 825 Lumens

Number of 15 W energy saver lamps required = $\frac{\text{total light output required}}{\text{light output per lamp}}$

$$= \frac{3960}{825}$$

$$= 4.8 \text{ round to 5 lamps} \quad \text{_____} \quad (6)$$

7. Pigs marketed/sow/yr = litters/sow.yr x litter size

$$= 2.483 \times 10.7$$

$$= 26.57 \text{ pigs/sow.yr}$$

Pigs marketed per year = pigs/sow.yr x number of sows

$$= 26.57 \times 140$$

$$= 3\,719.5 \text{ pigs/year}$$

Cold dressed mass of baconers = live mass x $\frac{\text{dressing \%}}{100}$

$$= \frac{85 \times 70}{100}$$

$$= 59.5 \text{ kg/baconer}$$

Value/baconer = cold dressed mass of baconer(kg) x price/kg $\left(\frac{R}{kg}\right)$

$$= 59.5 \times 21.24$$

$$= R1\,263.78/\text{baconer}$$

An. income for baconers = value/pig $\left(\frac{R}{pig}\right) \times \text{no pigs marketed} \left(\frac{pigs}{year}\right)$

$$= 1263.78 \times 3719.5$$

$$= R4\,700\,629.70/\text{year}$$

Mass of annual undiluted excretion

$$= \text{number of animals} \times \text{average body mass(kg)} \times \frac{\% \text{ daily excretion}}{100} \times \frac{365}{1000} \left(\frac{ton}{yr}\right)$$

$$= 1690 \times 50 \times \frac{7.2 \times 365}{100 \times 1000} \text{ t/yr}$$

$$= 2\,220.66 \text{ t/yr}$$

Annual income from excretion = Mass excretion/yr x expected price

$$= 2\,220.66 \times 329$$

$$= R730\,597.14/\text{yr}$$

Gross annual income = income from porkers + excretion

$$= 4\,700\,629.70 + 730\,597.14$$

$$= R5\,431\,226.84$$

Allowable annual expenditure on building

$$= \frac{\text{annual gross income} \times \% \text{income that can be spent on facility (table 2)}}{100}$$

$$= \frac{5431226.84 \times 10.5}{100}$$

$$= R570\,278.81$$

Annual cost as Percentage of initial cost from table = $7.06 + \frac{\text{interest rate}}{2}$

$$= 7.06 + \frac{14}{2}$$

$$= 14.06$$

Maximum investment in building = $\frac{\text{Allowable annual expenditure on building} \times 100}{\% \text{ annual ownership cost (table 1)}}$

$$= \frac{570278.81 \times 100}{14.06}$$

$$= R3\,700\,418$$

Because the maximum investment in buildings that the pig enterprise can support (R3700418) is greater than the estimated cost of the buildings (R3 500 000) then the enterprise will justify the cost of the buildings _____ (16)

8. Length of 215 mm foundation walls = 2(length x width) (20)
 $= 2(7.132 + 6.232)$
 $= 26.728 \text{ m}$

Volume of foundations for 215 mm walls = $l \times w \times h$
 $= 26.728 \times 0.7 \times 0.23$
 $= 4.303 \text{ m}^3$

Length of 102 mm walls = $(6.232 - 0.43) + 7.132 - 3.6 - 0.43 - 0.102 \text{ m}$
 $= 8.904 \text{ m}$

Volume of foundations for 90 mm wall = $l \times w \times h$
 $= 8.904 \times 0.46 \times 0.23$
 $= 0.946 \text{ m}^3$

Total volume of foundations = volume 215mm foundations + vol 102mm found.
 $= 4.303 + 0.946$
 $= 5.249 \text{ m}^3$

Vol. concrete in foundations allowing for 10% wastage = $\text{vol} \times \frac{100+10}{100}$
 $= 5.249 \times 1.1$
 $= 5.7739 \text{ m}^3$

Choose concrete mix D for foundations from table 6

Stone size = $\frac{\text{Minimum dimension of concrete (mm)}}{5}$
 $= \frac{230}{5}$
 $= 46 \text{ mm}$

Choose the next lowest stone size in table 2, stone size = 40 mm

Materials for foundations

Volume of concrete (m ³)	Cement (bags)	Sand (m ³)	Stone (m ³)	Water (litres)
1	5.0	0.70	0.85	30
5.739	28.87	4.04	4.908	866

Volume of floor = $l \times w \times h$
 $= (7.132 - 0.43) \times (6.232 - 0.43) \times 0.075$
 $= 6.702 \times 5.802 \times 0.075$
 $= 2.916 \text{ m}^3$

Vol. Concrete allowing for 10% wastage = $\text{vol} \times \frac{100+10}{100}$
 $= 2.916 \times 1.1$
 $= 3.2.8 \text{ m}^3$

From table 6, choose concrete mix C for light floors.

Stone size = $\frac{\text{Minimum dimension of concrete (mm)}}{5}$
 $= \frac{100}{5}$
 $= 20 \text{ mm}$

Choose the next lowest stone size in table 2, stone size = 20 mm

Materials for floor

Volume of concrete (m ³)	Cement (bags)	Sand (m ³)	Stone (m ³)	Water (litres)
1	6.4	0.70	0.77	25
3.208	20.53	2.25	2.47	513

Total materials for foundations and floor of 3 room house = materials for foundations + floor

Cement = $28.87 + 20.53 = 49.4$ round to 50 bags

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$$\text{Sand} = 4.04 + 2.47 = 6.51 \text{ m}^3$$

$$\text{Stone, 40mm} = 4.91 \text{ m}^3$$

$$\text{Stone, 20mm} = 2.47 \text{ m}^3$$

$$\text{Water} = 866 + 513 = 1\,379 \text{ litres}$$