



"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE & NATURAL SCIENCES

NAAE 201: FARM POWER AND MACHINERY

END OF SECOND SEMESTER FINAL EXAMINATIONS

APRIL 2023

LECTURER: MR. W. ZENDERA

DURATION: 3 HOURS

INSTRUCTIONS

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|--|----------|
| 1. Answer ALL question in Section A | 20 Marks |
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| 2. Answer four questions in Section B | 80 Marks |
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| 3. Begin Your Answer for Each Question on a New Page | |
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Section A

Answer All Questions, 20 Marks

Question 1

Given the information in Table 1 below, develop a contract rate for hiring out your new tractor.

For the Tractor		
Information required		
New price list	\$55 000	
Tractor Power	100 Hp	
Interest rate	12%	
Trade in Age	10 years	
Annual Usage (hours)	500	
Ownership costs	Working	Answer
Salvage value		
Average Value		
Depreciation cost (Straight line method)		
Interest		
Tax insurance and housing		
Total ownership costs		
Total ownership cost/hr		<i>[8 marks]</i>

Variable costs for Tractor

Variable costs for Tractor					
Item	Number	Costs	Rate/life	Variable costs summary	Variable costs/hr
Diesel		\$1.50	10l/hr		
Engine Oil		\$6.40/l	10 l/250 hrs		
Transmission oil		\$6.00/l	100l/1000hrs		
Filters					
Air filter		\$15	1500 hrs		
Fuel filter		\$25	500 hrs		
Oil filter		\$25	250 hrs		
Transmission oil filter		\$30	750 hrs		
Tyres					
Tyres (Large)	2	\$350	3000 hrs		
Tyres (small)	2	\$150	3000 hrs		
Battery	1	\$120	1000hrs		
Repair %		11% of List			
Maintenance		Price/year			
Other					
Total operating cost/hr					[8 marks]
Contract rate/hr					[4 marks]

Section B

Answer Four Questions, 80 Marks

Question 2

- a) State the possible causes of overheating in tractor engines. [5 marks]
- b) List the tractor maintenance activities to be carried out during the 50 hour service. [5 marks]
- c) Explain the steps one would take to trouble shoot a faulty starter motor. [10 marks]

Question 3

- a) Briefly explain the following accessories on tractors
 - i. The purpose of a differential on the final drives. [4 marks]
 - ii. The need for locking the differential. [3 marks]
 - iii. The purpose of having dual independent breaks on tractors. [3 marks]
- b) Outline two ways in which wheels tracks can be adjusted on tractors. [2 marks]
- c) Explain the purpose of ballasting on tractors. [4 marks]
- d) State and explain two types of ballasts used on tractors. [4 marks]

Question 4

- a) Explain the following types of maintenance strategies used in farm machinery:
 - i. Breakdown type of maintenance, [3 marks]
 - ii. Condition monitoring (predictive), [3 marks]
 - iii. Periodic maintenance (preventive). [3 marks]
- b) Explain the possible causes of the following types of smoke in diesel engines:
 - i. White smoke. [3 marks]
 - ii. Black smoke. [4 marks]
 - iii. Blue smoke. [4 marks]

Question 5

- a) Sketch and clearly label the theoretical pressure volume diagram for a modern compression ignition engine. [5 marks]
- b) Explain what is happening at each stage of the cycle in (a). [5 marks]
- c) A six cylinder has a bore of 70 mm and a stroke of 80 mm. If the clearance volume of one cylinder is 42 000 mm, calculate:
 - i. The compression ratio, [5 marks]
 - ii. The capacity of engine in litres. (1 litre = 10⁶) [5 marks]

Question 6

- a) Describe the effect of the following adjustments on a disc plough.
 - i. Horizontal angle. [3 marks]
 - ii. Tilt angle, [2 marks]
 - iii. Spacing between discs. [2 marks]
- b) Agitation of spray liquids is essential to prevent settling out of chemicals. Briefly describe the mode of function of two common types of agitators found in boom sprayers. [4 marks]
- c) You have a 6 m boom with 8 nozzles spaced at 75 cm apart. The average output nozzle is 3.5 l/min. The sprayer is equipped with a 380 l tank and will be used at a speed of 6.4 km/hr.
 - i. Calculate the application rate for this sprayer. [3 marks]
 - ii. If atrazine is to be sprayed in the field at a rate of 2.5 l/ha. How many litres of Atrazine will be required for the 380 litre tank. [3 marks]
 - iii. Calculate the area to be sprayed from one 380 litre tank. [3 marks]

Question 7

- a) Describe the working principle of a power steering. [6 marks]
- b) State the advantages of a power steering over a mechanical steering system. [4 marks]
- c) Describe the effect of the following in steering geometry:
 - i. Caster angle, [5 marks]
 - ii. Camber. [5 marks]

End of Examination Paper