AGRICULTURAL TECHNOLOGY

NOVEMBER 2016

MEMORANDUM

MARKS: 200

This memorandum consists of 15 pages.
SECTION A

QUESTION 1

1.1  1.1.1  C✓✓  (2)
     1.1.2  A✓✓  (2)
     1.1.3  D✓✓  (2)
     1.1.4  C✓✓  (2)
     1.1.5  B/C✓✓  (2)
     1.1.6  B✓✓  (2)
     1.1.7  B✓✓  (2)
     1.1.8  D✓✓  (2)
     1.1.9  D✓✓  (2)
     1.1.10  A✓✓  (2)
(10 x 2)  (20)

1.2  1.2.1  Biological/Bacteria✓✓  (2)
     1.2.2  area✓✓  (2)
     1.2.3  gear/speed/gear ratio ✓✓  (2)
     1.2.4  evaporation pan/tensiometer/moist meter✓✓  (2)
     1.2.5  Geothermal/geo✓✓  (2)
(5 x 2)  (10)

1.3  1.3.1  G or A✓✓  (2)
     1.3.2  A or G✓✓  (2)
     1.3.3  B✓✓  (2)
     1.3.4  C✓✓  (2)
     1.3.5  E✓✓  (2)
(5 x 2)  (10)

TOTAL SECTION A:  40
SECTION B

QUESTION 2: MATERIALS AND STRUCTURES

2.1 Explanation of why a copper hammer should be used
- When copper strikes against a hard surface, it will not generate sparks because it is soft.✓
- Steel hammers can cause a spark because the steel is harder.✓ (2)

2.2 THREE reasons for adding copper to metals to form an alloy
- Increases resistance to corrosion✓
- Increases conductivity✓
- Increase conducting of electricity✓ and heat✓
- Hygienic
- Easy to alloy (Any 3) (3)

2.3 Process used to soften tempered brass products for further working processes
Annealing (only the word, not the process)✓ (1)

2.4 2.4.1 Explanation of why metal cans must be coated with a thin tin layer
- To prevent corrosion of steel✓
- To prevent contamination of food (Any 1) (1)

2.4.2 THREE important properties of tin
- Silvery white✓
- Soft✓
- Malleable metal✓
- Can be highly polished
- Resists oxygen and water but dissolves in acids and bases (prevent rust)
- When heated in air, tin forms tin oxide
- Tin has a crystalline structure and when a tin bar is bent, a 'tin cry' is heard. (Any 3) (3)

2.5 THREE elements added to steel when manufacturing stainless steel
- Chromium✓
- Manganese✓
- Nickel✓ (3)

2.6 THREE aspects to consider when one needs to improve the cohesion properties of an adhesive
- Apply a thin base coat if the surface is very porous.✓
- Apply only a thin layer of adhesive.✓
- Apply adhesive to both surfaces.✓ (3)

2.7 Substance added to harden resin when doing fibreglass repairs
Catalyst/hardener/accelerator✓ (1)
2.8 2.8.1 Reason for suitability of Vesconite for marine application

- Water is an excellent lubricant for Vesconite.✓
- Making it suitable for both dry and immersed applications.
- Does not rust.
- Saltwater does not corrode the material.

(Any 1) (1)

2.8.2 THREE reasons why machining Vesconite holds no health risk to the person working with it

- Does not contain any asbestos/hazardous fibres✓
- Does not contain any lead✓
- Does not give off any poisonous gases/smoke when machined✓
- Does not rust

(Any 3) (3)

2.8.3 THREE reasons for choosing Vesconite over white metal when manufacturing bushes

- Higher design load limit than white metal✓
- Higher metal fatigue strength✓
- Two to three times better wear resistance capability✓
- Machined without the use of a coolant
- Does not shrink or expand
- Does not wear
- Will not damage the shaft

(Any 3) (3)

2.9 2.9.1 TWO preventative measures that can be followed to prevent lightning from damaging the energiser of an electric fence

- Install lightning protectors✓
- Switch off all electricity during thunderstorms✓
- Disconnect the battery.

(Any 2 reasonable answers) (2)

2.9.2 Description of TWO methods that can be used to protect a permanent electric fence energiser system from theft

- Install it high on a long pole out of reach of people✓
- Locked into a metal or concrete structure✓

(2)

2.9.3 THREE design requirements prescribed for the warning signs that are used on an electric fence

- The signs must be at least 100 mm x 200 mm✓
- The background colour of both sides must be yellow✓
- The inscription must be black and must read 'TAKE CARE – ELECTRIC FENCE'.✓
- The inscription must be clear, inscribed on both sides and have a height of at least 25 mm.
- At least two languages must be used on a sign.

(Any 3) (3)
2.9.4 **TWO solutions to overcome the problem of reduced earthing efficiency in electric fences due to very dry soil**

- Increase the number of earth spikes.
- Run an earth return wire parallel to the fence line and connect it to earth spikes at regular intervals.

2.9.5 **TWO rules or regulations that an electric fence, which is erected next to a public road, must adhere to**

- Mount the electrified wires in such a way that people cannot inadvertently come into contact with them.
- Display warning signs to inform people that the property is protected by an electric fence.
- Electrical fences must never be erected parallel underneath overhead power lines because a higher current can be induced in the fence by the overhead power lines.
- Barbed wire is not allowed in the construction of an electric fence.
- 3–10 meters away from the road

(Any 2)
QUESTION 3: ENERGY

3.1 3.1.1 Identification of parts A and B of the wind turbine
A  Rotor/Propeller✓ (nose cone, cone head)
B  Gear box✓ (transmission, gear) (2)

3.1.2 TWO problems associated with wind turbines used to generate electrical energy
- The unreliability of the wind✓
- Generates a lot less energy than fossil energy✓
- Initial installation cost is high
- Noise pollution
- Protest and petitions against countryside invasion
- Mechanical failure (Any 2) (2)

3.1.3 Name and description of TWO devices installed on the wind turbine that ensures maximum efficiency of the turbine blades
- Wind direction meter:✓ Orientates the rotor/propeller properly into the wind. ✓ (2)
- Wind speed meter:✓ Orientates the pitch of the blades to effectively harness the available wind power. (Turning faster or slower)✓
- Gearbox. Installing an automatic gearbox/synchronised gearbox (Any 2) (2)

3.2 TWO different systems that can be used to produce hot water in this situation
- Solar/Sun hot water system✓
- Electrical solar/sun panel system✓
- To heat the water with a wood or coal fire under a container
- Diesel/petrol/paraffin/gas engine generator (Any 2) (2)

3.3 THREE economic factors that influence the production of biofuel
- Fuel price✓
- Certain food crops like maize are needed to make biofuel which may lead to an imbalance✓
- A huge quantity of water is required which may affect the local water resources✓
- The more land to produce crops for biofuel, the more habitats for animals and wild plants will be lost.
- If biofuel generates more profit for farmers, they may grow crops for biofuel production instead of food production.
- Lower food production will increase food prices and cause a rise in inflation. (Any 3) (3)
3.4 **Description of how electricity is generated in the hydro-electric plant**
- It needs a constant downward water flow.
- This is achieved by using rushing water that is obtained from dams.
- Water enters the intake pipes of the turbines which make them spin.
- The turbines are connected to generators that produce electricity.  

3.5 **THREE applications for photovoltaic cells on a farm**
- Electric power for the farmhouse
- Water pumping
- Security systems
- Communication systems
- Electric gates
- Electric fences

(Any 3 acceptable answers)
4.1 **Explanation of what will happen when water enters the torch of the plasma cutter nozzle**
- Water entering the torch nozzle can cause internal arcing/a short circuit. ✓
- This arcing will damage the torch. ✓

4.1.2 **TWO reasons for using the welding helmet when doing plasma cutting**
- The visor blocks the ultraviolet rays. ✓
- It covers the whole face of the operator. ✓
- Protects face and eyes against heat.
- Protects face and eyes against sparks.

4.1.3 **Identification of nozzle used for plasma cutting**
C ✓

4.2 **TWO kinds of wear that the bucket of the front-end loader can be subjected to when working**
- Metal against metal friction ✓
- Serious jolts or shocks of metal against rock ✓
- Scraping plus jolts and shocks
- Serious scraping

4.3 4.3.1 **THREE ways of controlling distortion of the welded joint**
- Pre-setting ✓
- Welding of patch work ✓
- Clamping ✓
- Spot welding
- Pre-heating

4.3.2 **THREE factors that influence the amount of distortion of a welded joint**
- Amount of welding ✓
- Number of welding runs ✓
- Degree of resistance ✓
- Original state or condition of parts that must be welded
- Welding procedure
- Cooling process
- Thickness of the metal
4.4 **TWO** labelled sketches to indicate the difference between a horizontal arc welding butt joint and a vertical up arc welding butt joint when the metal is 6mm thick

![Horizontal and Vertical Butt Joint Sketches](image)

- Drawing correct: 1 mark
- Indicated V-groove: 1 mark

(4)

4.5 **Description of the procedure that must be followed to cut a 10 mm steel plate when using the oxyacetylene apparatus**

- Set the flame to a cutting flame.
- First bring the material up to red hot.
- Oxygen is then fed with the lever on the cutting attachment.
- The steel actually ignites giving off more heat to keep the process going.
- The steel turns into a liquid.
- The iron liquid is cleared from the cut by pressure from the oxygen stream.
- Safety regulations/measures

(Any 5)

4.6 **4.6.1 The gauge that is used for MIG welding**
- B

(1)

**4.6.2 Factors that must be considered when MIG welding is done on galvanised steel**
- Galvanising must be removed prior to the welding.
- The galvanising interrupts the welding arc making welding difficult.
- The gases created when welding galvanised steel are poisonous.
- Wear gas mask.

(Any 2)
4.6.3 THREE disadvantages of MIG welding.
- MIG welding can only be used on thin to medium thick metals.
- The use of an inert gas cylinder makes this type of welding less portable.
- Produces a less controlled weld as compared to Tungsten Inert Gas Welding (TIG).
- Higher initial setup cost.
- Atmosphere surrounding the welding process has to be stable; therefore, this process is limited to draught-free conditions.
- Higher maintenance costs due to extra electronic components.
- The setting of plant variables requires a high skill level.
- Less efficient where high-duty cycle requirements are necessary.
- Radiation effects are more severe.

(Any 3)

4.7 Calculation of the number of welding rods needed to complete the job

Circumference of circle = \( \pi \times d \)
\[
3.14 \times 100 = 314 \text{ mm}
\]
\[
\frac{314}{105} = 2.99 \text{ welding rods}
\]
\[
= 3 \text{ rods}
\]

4.8 Drawing of a two-station arc welding table

Design: 2 marks (One station -1 mark)
Dimensions: 1 mark
Safety feature: 1 mark
Labels: 1 mark

[35]
QUESTION 5: TOOLS, IMPLEMENTS AND EQUIPMENT

5.1 5.1.1 Match the correct implement in COLUMN B with the tractor in COLUMN A.
(a) C ✓
(b) A ✓
(c) B ✓ (3)

5.1.2 FOUR reasons why tractor (c) is a better choice than tractor (a) for work in a vineyard
- Smaller financial expenditure ✓
- Cost effective ✓
- Less diesel will be used ✓
- Cheaper maintenance cost ✓
- Tractor fits well into narrow rows
- Tractor does not compact the soil
- The exhaust pipe must be below the tractor
(Any 4) (4)

5.1.3 FOUR technological advanced devices that tractor (a) must be equipped with to make it highly efficient for precision spraying on a commercial farm
- Variable Rate Technology (VRT) ✓
- GPS ✓
- Four-wheel driving ✓
- Air conditioner ✓
- Power steering
- Hydraulic or pneumatic couplings
(Any 4) (4)

5.2 Names of parts A, B and C in the transmission assembly
A – Flywheel ✓
B – Clutch plate ✓
C – Pressure plate ✓ (3)

5.3 5.3.1 Identification of the two types of baling machines A and B
A Round baler/Roller type ✓
B Rectangular baler/Ram or piston type ✓ (square, big pack) (2)

5.3.2 Description of how the bale density can be changed in baler B
By increasing or decreasing the resistance to the hay moving through the baling chamber ✓ (2)

5.3.3 THREE reasons why a farmer will prefer baler B instead of baler A when baling hay
- Storage space optimally utilised ✓
- Bales stored easily ✓
- Continuous baling process ✓
- Transport space optimally utilised
- Easier feeding/handling (Any 3)
5.4 Description of the process of harvesting maize with a combine harvester
- The shears cut the plants.
- Maize is fed by the pick-up wheel to the auger.
- The auger feeds the material to the thresher chamber.
- The hammers separate the material.
- The blowers separate the light material from the heavy material.
- The sieve separates the coarser material from the maize kernels.
- The maize is then fed through the auger to the collecting bin. (Any 5) (5)

5.5 THREE safety requirements when working with the hammer mill
- Do not work on the machine while it is still in motion.
- Ensure that there are no loose objects lying inside the machine when starting it.
- Wear safety goggles/equipment.
- Do not use the machine when the rotor is out of balance.
- Driving mechanism must be screened off.
- Use in a well-ventilated area.
- Small pieces of scrap metal must be kept away from fodder because it can cause a spark, which can cause an explosion. (Any 3) (3)

5.6 Identification of the TWO types of hydraulic cylinders
A Single-action cylinder
B Double-action cylinder (2)

5.7 Explanation of why the drive shaft must be equipped with a sliding joint
During work the distance between the tractor and implement varies. (2)

5.8 TWO running expenses with regard to a tractor that the farmer must take into consideration when doing financial planning
- Repairs
- Lubricants (oil and grease)
- Labour
- Antifreeze
- Tyres
- Supervising expenses
- Fuel (Any 2) (2)

5.9 5.9.1 Determination of the gear ratio of the final drive
1 : 2 (1)

5.9.2 Explanation of why the final drive increases the torque
The drive gear is smaller than the driven gear. This means that the speed is reduced, thus increasing the torque. (2)

5.9.3 Calculation of the speed of the driven gear
200/2 = 100 r/min (2)

[40]
QUESTION 6: WATER MANAGEMENT

6.1 THREE problems associated with irrigation in South Africa
- Competition for surface water rights✓
- Depletion of underground aquifers✓
- Ground subsidence✓
- Under-irrigation increases soil salinity
- Over-irrigation wastes water
- Deep drainage may result in rising water tables
- Irrigation with saline or high-sodium water may damage soil structure/pollution
- Drought
- Price of water

(Any 3) (3)

6.2 6.2.1 Description of the construction of the centre pivot irrigation system
- The system consists of several segments of pipes (usually galvanised steel or aluminium) joined together.✓
- Supported by trusses.✓
- Mounted on wheeled towers.✓
- Sprinklers positioned along its length/Spacing of sprinklers.
- Wheels are driven by electric motors.

(Any 3) (3)

6.2.2 Function of a smart controller in the working of a centre-pivot irrigation system.
The smart controller is a controller that is capable of adjusting the watering time by itself ✓ in response to current environmental conditions.✓

(2)

6.2.3 TWO data sources from where the smart controller gets its data
- Soil moisture sensors✓
- Rain sensor✓
- Satellites/weather stations
- Historic weather data

(Any 2) (2)

6.2.4 TWO disadvantages of the use of large centre-pivot irrigation systems
- The centre pivot cannot be used on uneven land.✓
- Water delivery at the edge of the land is so high that water tends to run off.✓
- (Even) Water delivery becomes problematic.

(Any 2) (2)

6.2.5 A reason why most centre-pivot irrigation systems have drop pipes with sprinkler heads that are placed a few centimetres above the crop
To limit evaporation ✓ (wind blows water away)

(1)
6.3 **Brief explanation of how a home fire suppression system works**
- The sprinkler head is attached to the ceiling, with the top of the head facing down.
- Built into the sprinkler head is a heat/smoke-sensitive bulb or a two-part metal link that is held together with an alloy.
- The bulb or metal lies across the top of the head and acts as a plug to keep the opening closed.
- This breaks when heated, the alloy melts and water is released which extinguishes the fire.

(Any 3) (3)

6.4 6.4.1 **The name of the micro-organism that breaks down the raw sewerage in a septic tank**
Bacteria

(1)

6.4.2 **Explanation of why the inlet pipe of a septic tanks ends into a T-fitting or baffle**
Preventing the effluent from flowing straight across from one pipe to the other (solids dropping down)

(1)

6.4.3 **THREE aspects to remember in the maintenance of a septic tank**
- The septic tank is pumped out periodically.
- The frequency of pumping out will depend primarily on the amount of waste water that goes through the system each day.
- The frequency also depends on how careful you are about not throwing excess fats and other similar garbage down the drains.
- The more solid waste thrown in the system, the quicker the tank will fill up.
- Heavy flows of water also tend to make the tank fill up more quickly.
- Do not use a garbage disposal in the system when you have a septic tank.

(Any 3) (3)

6.5 **Brief explanation of the construction of a French drain system**
A French drain is basically a ditch dug around the foundation's perimeter filled with fine gravel to let the water flow away from the building structure.

(1)

6.6 6.6.1 **Working of the water purification system**
- The system uses three cartridges to filter the water.
- They are connected to the incoming water pipes, and provide clean water for the entire house.
- The first and second filters have very fine filament filters of 0,2 microns.
- The third filter is a carbon filter.

(Any 3) (3)
6.6.2 **Calculation of the time that it will take to fill a tank with water**

\[
\text{Time} = \frac{\text{Content}}{\text{Flow rate}}
\]

\[
= \frac{10\,000\,\text{ℓ}}{50\,\text{ℓ/min}}
\]

\[
= 200\,\text{min} \quad \text{or (3 hours 20 minutes)}
\]

(3)

6.7 **Description of how data integration through a GIS works on a combine harvester**

- Yield monitors are crop yield measuring devices installed on harvesting equipment.
- The yield data from the monitor is recorded and stored at regular intervals along with positional data received from the GPS unit.
- GIS software takes the yield data and produces yield maps.

(Any 2) (2)

[30]

TOTAL SECTION B: 160
GRAND TOTAL: 200