MARKS: 200

These marking guidelines consist of 16 pages.
SECTION A

QUESTION 1

1.1
1.1.1 C ✓ ✓
1.1.2 A ✓ ✓
1.1.3 A ✓ ✓
1.1.4 D ✓ ✓
1.1.5 C ✓ ✓
1.1.6 D ✓ ✓
1.1.7 B ✓ ✓
1.1.8 D ✓ ✓
1.1.9 C ✓ ✓
1.1.10 A/D ✓ ✓

(20)

1.2
1.2.1 Heat/steam/warmth/magma ✓ ✓
1.2.2 moveable ✓ ✓
1.2.3 standardisation ✓ ✓
1.2.4 more ✓ ✓
1.2.5 Battery/Accumulator ✓ ✓

(10)

1.3
1.3.1 G ✓ ✓
1.3.2 D ✓ ✓
1.3.3 F ✓ ✓
1.3.4 B/H ✓ ✓
1.3.5 A ✓ ✓

(10)

TOTAL SECTION A: 40
SECTION B

QUESTION 2: MATERIALS AND STRUCTURES

2.1 The alloy metal that is specifically used to manufacture the products and a reason why the metal is used.

2.1.1 Wine tanks

Stainless steel.✓
- Resistant to air, water and many chemical acids and alkali.✓
- Resistant against corrosion.✓
- Can be welded well.✓

(Any 1) (2)

2.1.2 Fittings for hot-water copper pipes

Brass. ✓
- Strength ✓
- Machinability ✓
- Wear resistance ✓
- Hardness ✓
- Corrosion resistance ✓

(Any 1) (2)

2.1.3 Hammers that can be used in explosive atmosphere

Bronze ✓
- Does not generate sparks ✓
- Low friction ✓

(Any 1) (2)

2.2 ONE example where the following materials will be used on a farm.

2.2.1 High-tensile steel

- Tow bar ✓
- Shafts ✓
- Gears ✓
- Crowbar ✓

(Any 1) (1)

2.2.2 Cast iron

- Engine block ✓
- Differential of the tractor ✓
- Cast iron pots ✓
- Tractor weights ✓
- Brake drum ✓
- Hubs for farm equipment ✓

(Any 1) (1)

2.3 Description of the annealing process of copper.

Heat the metal to 500–550°C ✓ Then cool it in the air or sand.✓
2.4 2.4.1 The TWO most important aspects that must be considered when an adhesive is chosen to repair the water trough.

- Type of the material to be joined. ✓
- Conditions under which this joint will be used. ✓

2.4.2 Process of preparing the water trough before the adhesive is applied.

Clean the surface area around the crack ✓ and sand it lightly until there are no more signs of dirt, clean before applying the adhesive. ✓

2.4.3 TWO methods used to join fibreglass parts.

- Pop rivet ✓
- Bolt and nut ✓
- Screws ✓

2.4.4 TWO methods of colouring a fibreglass trough.

- Painting ✓
- Dying ✓

2.5 The effect of extreme heat on the following material.

2.5.1 Bakelite

- No effect. ✓
- Will become extremely hot. ✓
- Will discolour. 

(Any 1) (1)

2.5.2 Perspex

- It will easily change shape when heated, because Perspex is not heat resistant. ✓
- It will burn. ✓
- It will melt ✓

(Any 1) (1)

2.5.3 Silicon

- Silicon will melt. ✓
- Will deform. ✓

(Any 1) (1)

2.6 Description of the friction ability of Vesconite.

- Low static and dynamic friction ✓
- No friction in tough working environments whether dry or wet, lightly or heavily loaded. ✓

(2)
2.7 2.7.1 **THREE design requirements prescribed for warning signs on electric fences.**

- The signs must be at least 100 mm x 200 mm.✓
- The background color of both sides must be yellow.✓
- The inscription must be black and must read 'BE AWARE—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 visible on the sign.✓ (Any 3) (3)

2.7.2 **TWO situations where an electrical fence can be used on a farm.**

- Protection✓
- Temporary fences✓
- Dangerous animals, e.g. lions✓ (Any 2)
- Around the farm perimeter (Any 2)

2.7.3 **TWO alternative energy sources that can be used to provide energy for an electrical fence.**

- Wind✓
- Solar✓
- Hydro electric✓
- Generator✓
- Battery✓ (2)

2.8 **THREE components needed to create a fire.**

- Material that can burn✓
- Oxygen✓
- Any heat source✓ (lightning / friction, matches, lighter) (3)

2.9 **TWO reasons for using resin casting as an insulating material when joining THREE phase electrical wires.**

- Watertight✓
- Non-conductor of electricity✓
- Toughness✓
- Prevents corrosion/ rust✓ (Any 2) (2) [35]
QUESTION 3: ENERGY

3.1 3.1.1 The energy source that makes use of a generator.

Source C ✓ (1)

3.1.2 Description of the working principles of energy source B.

- Cold water passes through glass tubes where it is heated by sun energy. ✓
- The heated water enters the geyser through a closed copper pipe network that runs through the geyser. ✓
- The hot water inside the copper pipes heats up the cold water inside the geyser. ✓
- The cooled water flows downwards back to the solar tubes where it is reheated. ✓ (Any 3)

Alternative geyser system.

- The sun heats up the liquid in the glass tubes ✓
- That heat up the element. ✓
- The copper element heats up the water. ✓

3.1.3 The device that must be connected to energy source A to change the direct current to alternating current.

Inverter ✓ (1)

3.1.4 Identify energy source C.

Concentrated solar/Solar plant/Sun tower ✓ (1)

3.2 TWO disadvantages of a wind turbine’s blades turning too fast.

- The blades could be damaged. ✓
- The rotor experiences too much strain. ✓
- The structure could collapse. ✓
- Noise pollution. ✓
- Bird strikes (Any 2) (2)

3.3 THREE geographical challenges that may arise during a survey for a geothermal energy power station.

- Is the rock soft enough to drill through? ✓
- Do the rocks deep down contain sufficient heat? ✓
- Will this heat be sustainable for a significant amount of time? ✓
- Is the environment fit for a power plant? ✓
- Volcanic activities ✓
- Accessibility/Difficult to locate ✓
- Availability of water (Any 3) (3)
3.4 3.4.1 An alternative racing fuel that can be used to supplement petroleum.

Methanol ✓

3.4.2 THREE materials used to manufacture the alternative fuel (Methanol).

- Woody plant fibre ✓
- Methane gas in landfills ✓
- Coal ✓
- Natural gas ✓
- Fermented waste products such as sewage and manure ✓ (Any 3) (3)

3.5 3.5.1 THREE disadvantages associated with a hydroelectric power plant.

- Limited plant locations ✓
- High initial costs ✓
- Carbon emission ✓
- Flood risk ✓
- Susceptible to earthquakes/tremors ✓
- Limited water resources ✓
- Affects marine life ✓
- High costs ✓ (Any 3) (3)

3.5.2 TWO reasons why hydroelectric power plants are limited in South Africa.

- Water scarcity ✓
- Inadequate water flow ✓
- Non-sustainable water in rivers ✓
- Inadequate land gradient ✓
- High costs ✓ (Any 2) (2) [20]
QUESTION 4: SKILLS AND CONSTRUCTION PROCESSES

4.1 4.1.1 Parts A and B.

A- Earth clamp/Clamp✓
B- Welding/gun/torch✓

(2)

4.1.2 The apparatus that can be attached for welding aluminium.

Push Pull torch✓

(1)

4.1.3 TWO gases that can be used with MIG welding.

- Argon✓
- Helium✓
- Mixture of Co2 and Argon✓

(Any 2) (2)

4.1.4 THREE different metals that can successfully be welded with the MIG-welding machine.

- High alloy steel (stainless alloys) ✓
- Aluminium✓
- Mild steel✓

(3)

4.2 4.2.1 The material used for part A.

- Tungsten✓
- Copper mounted hafnium✓
- Zirconium✓

(Any 1) (1)

4.2.2 Description of the plasma cutting process.

The process involves using a tungsten electrode, ✓ and high pressure plasma✓ (which is gas in an ionized state) to generate and carry an electrical arc between a copper nozzle and work piece. ✓

The electrical arc performs the cutting, but the pressurized plasma helps to keep the cut cleared by removing the dross (metal impurities generated by the cutting). ✓

(Any 3) (3)

4.3 TWO types of metals that can be cut by using the oxy-acetylene.

- Mild steel✓
- Cast iron✓
- Stainless steel✓
- Any ferrous metals✓

(Any 2) (2)
4.4 **Description of the process of shutting down an oxy-acetylene flame and bleeding the system.**

- Turn off the acetylene valve on the torch handle. This will extinguish the flame. ✓
- Turn off the oxygen valve on the torch handle. ✓
- Shut/close the main cylinder valves clockwise on the top of both gas cylinders. ✓
- Now open the two valves on the torch handle to 'bleed' the system. ✓
- Turn both the oxygen and acetylene regulator handles counter-clockwise until they are loose. ✓
- Close both valves on the torch handle. ✓
- Put the handle and tips away, and return the gas cylinders and their hoses to their proper storage area. ✓

(Any 5) (5)

4.5 4.5.1 **Description of the process of vertical up arc welding.**

- A special electrode is used for vertical welding with an arc welder, makes the process easier as it 'freezes' more quickly. ✓
- Amperage can be reduced slightly from the normal down hand setting. ✓
- Tip of the electrode must be pointed upwards, so that the electrode forms an angle of up to 30° with the horizontal plane. ✓
- Arc must be kept short and the speed must be just sufficient to prevent the molten metal from the puddle to run down. ✓
- When welding up, very little lateral movements of the electrode must be made. ✓

(5)

4.5.2 **Draw THREE different types of welding runs used for vertical welding.**

(Any 3 drawings) ✓ ✓ ✓

4.6 4.6.1 **Calculation of the volume of concrete needed.**

**Formula:** Volume = Length x width x height

\[ 2 \text{ 500 mm} \times 1 \text{ 200 mm} \times 250 \text{ mm} = 750 \text{ 000 000 mm}^3 \]

OR

\[ 2,5 \text{ m} \times 1,2 \text{ m} \times 0,25 \text{ m} = 0,750 \text{ m}^3 \]

(Allocate full marks if only the final answer is given)

(3)
4.6.2 Design and sketch of a shelter to protect the generator from weather conditions. Show at least TWO measurements.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof and construction</td>
<td>(2)</td>
</tr>
<tr>
<td>Poles (Uprights)</td>
<td>(1)</td>
</tr>
<tr>
<td>Measurements</td>
<td>(1)</td>
</tr>
<tr>
<td>Neatness</td>
<td>(1)</td>
</tr>
</tbody>
</table>

(5)

[35]
QUESTION 5: TOOLS, IMPLEMENTS AND EQUIPMENT

5.1 5.1.1 TWO measures the farmer can apply to ensure that the maize will be harvested on time.

- Making use of contractors.
- Working longer hours.
- Making use of bigger harvesting machines.
- Harvest until the rain start. (Any 2) (2)

5.1.2 An alternative method that can be used, other than the combine harvester and justification.

Hand harvesting/You can continue to harvest by hand whilst it is raining/ Use a tractor drawn harvester. (Any 1) (2)

Justification: Combine harvester will be stuck in the field when soil is wet.

5.2 5.2.1 THREE aspects to bear in mind when buying a new baler.

- Price
- Local maintenance services
- Parts locally available
- Driving power needed for operation
- Type of baler
- Ease of operation
- Type of binding technique (Any 3) (3)

5.2.2 THREE points to consider before buying a second-hand baler.

- Reliability of the agent
- Spare parts easily available
- Well proven model
- Guarantee from agent/seller
- General wear and tear (Any 3) (3)

5.3 5.3.1 Less space-consuming bale.

A (1)

5.3.2 Justification for answer in QUESTION 5.3.1

More bales can be stacked on a truck.
No gaps between the bales.
Bales are compact (Any 1)
5.3.3 The bale that can be wrapped.

A or B✓

5.3.4 A reason why baling process B can be used up until raining.

Water runs down the bale/ bale can be stored outside.✓

5.3.5 FIVE round-baler safety tips to young upcoming farmers.

- Familiarise yourself with the operator's manual.✓
- Adequate training must take place.✓
- Ensure all safety screens are in place.✓
- Be watchful when backing up as baler is bulky and reduces vision to the rear.✓
- Avoid sharp turning.✓
- Assure no one is near the rear gate when it is being raised and lowered.✓
- Keep everyone clear of the rear of the baler during unloading.✓
- Large round bales can roll after discharge when on hilly terrain.✓
- Before servicing, cleaning, or adjusting a round baler, disengage the tractor PTO.✓
- Block the gate before working under it. Use the safety lock system for the baler.✓
- Keep the PTO properly shielded.✓
- Never allow passengers to ride on the baler during operation or transport.✓
- Be extremely cautious when operating a baler on uneven or hilly terrain.✓
- Raise the pickup to clear humps and obstacles when passing over uneven terrain.✓

(Any 5) (5)

5.4 5.4.1 The type of belt best fitted on the pulley system and ONE reason for identifying it.

V-belts✓

AND
- Does not easily slip off.✓
- Draw tighter around pulleys.✓
- No lubrication needed.✓
- Lasts longer.✓

(Any 1) (2)

5.4.2 Changing the direction in which pulley A rotates.

By twisting the belts.✓
Switch the motor to the other side.✓
Change the polarity of the motor.✓

(Any 1) (1)
5.5 5.5.1 **The different types of gears, A and B.**

A- Straight cut gear/ Spur gear ✓
B- Helical gear ✓

5.5.2 **Calculation and ratio of gear connection.**

**Driver gear (128 teeth)**
**Driven gear (16 teeth)**

Driver gear

\[ \frac{\text{Driver gear}}{\text{Driven gear}} = \frac{128}{16} \]

\[ = 8 : 1 \]

5.5.3 **ONE advantage and ONE disadvantage of each gearing system.**

<table>
<thead>
<tr>
<th>GEAR</th>
<th>ADVANTAGE</th>
<th>DISADVANTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spur gear (A)</td>
<td>Easy to manufacture ✓ Cheaper to manufacture ✓ (Any 1)</td>
<td>Noisy ✓ Cannot use in synchronised gearbox ✓ Difficult to mash ✓ Subject to wear ✓ (Any 1)</td>
</tr>
<tr>
<td>Helical gear (B)</td>
<td>Lasts longer ✓ Easy to mash ✓ Less wear ✓ More contact point of teeth ✓ (Any 1)</td>
<td>Subjected to side thrust ✓ More expensive to manufacture ✓ (Any 1)</td>
</tr>
</tbody>
</table>

5.5.4 **The gear system to improve speed.**

A ✓ ✓

5.6 5.6.1 **Cylinder types.**

A- Double (action) cylinder ✓
B- Single (action) cylinder ✓

5.6.2 **The cylinder best fitted on a front-end loader.**

A- Double action cylinder ✓

5.6.3 **Explanation to support answer given in QUIESTION 5.6.2.**

It enables the operator to set the control lever in a down ✓ and upward thrust position ✓
5.6.4 **TWO reasons to justify the use of transmission oil in a tractor hydraulic system.**

- Not compressible ✓
- Good lubrication qualities ✓
- Not volatile ✓
- Relatively cheap ✓

(Any 2) (2)

**QUESTION 6: WATER MANAGEMENT**

6.1 **Irrigation components and their function.**

6.1.1 Irrigation timer/Irrigation controller/Smart controller ✓ (1)

6.1.2 An irrigation timer controls the flow of water by turning on and off. ✓
Used for scheduling irrigation. ✓ (Any 1) (1)

6.1.3 Electronic valve/ Solenoid valve/ Irrigation valve ✓ (1)

6.1.4 An irrigation valve regulates the one-directional flow of water in an irrigation system ✓ (1)

6.1.5 Sprinkler/sprayer ✓ (1)

6.1.6 An irrigation sprinkler drops water onto the land, mimicking the effects of rain. ✓ (1)

6.2 **TWO reasons for determining the flow rate of the pump.**

- For correct calibrating of the sprayers. ✓
- Effective scheduling of irrigation. ✓
- To prevent the over/under utilisation of the water source. (Any 2) (2)

6.2.2 **Calculation of the flow rate.**

Flow rate = Content ÷ Time

= 10 000 ÷ 8 ✓

= 1 250 Litres/minute ✓ (3)

6.3 **Type of device suitable to send the location.**

- GPS ✓
- Cell phone ✓
- Tablet
- Tablet

(Any 1) (1)
6.4 6.4.1 The irrigation system, best suitable for a land against steep slopes with motivation.

- B ✓

AND

- Prevents run off water. ✓
- Pivots mainly used on level surfaces. ✓
- Does not cause soil erosion. ✓

(Any 2) (3)

6.4.2 Reasons for preferring irrigation system A.

- Not necessary to remove system. ✓
- Can work with implements on land. ✓
- Animals cannot damage system. ✓
- Less time consuming. ✓
- Less labour intensive. ✓
- Remote control/management. ✓
- Variable rate irrigation. ✓

(Any 2) (2)

6.5 6.5.1 The design error of the septic tank.

- The outlet is higher than the inlet. ✓
- No partition wall. ✓
- There will be a backflow of waste water. ✓

(Any 2) (2)

6.5.2 The importance of installing a manhole in a septic tank.

- General maintenance ✓
- Removing of solids ✓
- Inspection ✓
- Adding bacteria ✓
- Unclogging of in/outlet ✓

(Any 4) (4)

6.5.3 Suitable drainage system to be connected to the septic tanks outlet.

- French drain ✓
- Pebble/stone drain ✓
- Drainage field ✓

(Any 1) (1)

6.6 The main cause of blockages in a town's sewage system.

- The disposal of non-degradable materials. ✓
- The lack of maintenance. ✓
- Missing manhole lids. ✓
- Root obstructions. ✓
- Too many people using the system. ✓

(Any 1) (1)
6.7  6.7.1 **The type of filter to connect with a water softener.**

A ✓

(1)

6.7.2 **The filter that is installed to a micro irrigation system.**

F ✓

(1)

6.7.3 **ONE example where the filter shown in C will be used.**

- Micro irrigation ✓
- Swimming pool ✓

(Any 1)

(1)

6.7.4 **Correct statement.**

Filtration always takes place from the outside ✓ to the inside ✓ of the filter.

(2)

[30]

TOTAL SECTION B: 160
GRAND TOTAL: 200