



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2018

**MECHANICAL TECHNOLOGY
WELDING AND METAL WORK
MARKING GUIDELINE**

MARKS: 200

This marking guideline consists of 12 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC) (COMPULSORY)

- 1.1 B ✓
- 1.2 C ✓
- 1.3 D ✓
- 1.4 D ✓
- 1.5 B ✓
- 1.6 A ✓
- 1.7 C ✓
- 1.8 C ✓
- 1.9 D ✓
- 1.10 A ✓
- 1.11 C ✓
- 1.12 B ✓
- 1.13 A ✓
- 1.14 D ✓
- 1.15 C ✓
- 1.16 B ✓
- 1.17 A ✓
- 1.18 D ✓
- 1.19 C ✓
- 1.20 C ✓

(20 x 1) [20]

QUESTION 2: SAFETY**2.1 Arc Welding Equipment:**

Wear approved personal protective equipment (PPE). ✓

Wear PPE that is fire - resistant to protect the welder against sparks, etc. ✓

Use completely insulated electrode holders. ✓

At no time strike an arc without protecting your eyes with a helmet or welding shield.

Always wear safety goggles to protect your eyes from particles of metal and chips of slag.

Stand and work only in dry surroundings.

Always keep your hands and clothing dry.

(Any 3) (3)

2.2 General machine safety:

The working area around all machines must be clearly indicated. ✓

All moving parts must be covered by rigidly constructed guards. ✓

If access to a machine is necessary, the guard must be able to hinge or slide open while the machine automatically switches off. ✓

No machine may be operated if any of the guards are missing or broken.

(Any 3) (3)

2.3 Bending press(Box and Pan)

Before use, check if the machine is mounted securely, especially the bench-mounted type. ✓

Make sure not to exceed the indicated load limit (thickness of the sheet metal) of the machine. ✓

Use this machine only to bend sheet metal, not rods or angle iron. ✓

Do not use any extensions on the folding bar levers.

(Any 3) (3)

2.4 Reporting to persons in charge (C3)**The worker must report:**

Maintenance requirements of machines or equipment so that the flow of production is not interrupted. ✓

Progress on work in operation.

Problems encountered in the manufacturing process.

Material and equipment requirements.

Accidents immediately.

(Any 1) (1)

2.5 Angle grinder:**The safety guard must be in place before you can start the grinding process.**

Protective shields must be placed around the object being ground to protect passers-by. ✓

Use the correct grinding disc for the job. ✓

Do not use excessive force while grinding and cutting. ✓

Make sure that there are no cracks on the disc before you start a job.

Protective clothing and eye protection are essential when working with an angle grinder.

Beware of lockable switches in the 'on' position when machine is plugged in and switched on.

(Any 3) (3)

2.6 Drill press safety:

Clamp the work piece securely to the table and do not hold it by hand. ✓

(1)

2.7 Surface grinder:

Protective clothing and eye protection are essential when operating a surface grinder. ✓

Understand the operating instructions applicable to your machine. ✓

Do not operate the surface grinder unless all guards and safety devices are in place and working correctly. ✓

Never clean or adjust the machine while it is in motion.

Immediately report any dangerous defects of the machine and stop using it until it has been repaired by a qualified person.

Do not use excessive force when drilling into the work piece.

(Any 3) (3)

2.8 PPE Gas welding:

Overall ✓

Leather gloves ✓

Welding goggles ✓

Welding spats

Safety boots

(Any 3) (3)

2.9 Unsafe conditions in the workshop:

Insufficient lighting in the working area to the extent that the worker cannot clearly see what he or she is doing. ✓

Insufficient ventilation, especially where welding, grinding, testing of petrol or diesel engines, or work involving chemicals is being carried out. ✓

Working in an area where construction is taking place.

Working in an area where the floor is unsafe due to its being unstable, cracked, full of holes, weakened by rotten floorboards or wet due to liquid spills, especially oily ones.

Badly planned workshop layout.

Workshop that is crowded, with piles of materials and / or equipment in passageways and working areas.

Blocked or not clearly marked emergency exits.

A lack of suitable machine emergency exits.

A lack of suitable machine guards and guard rails. (Any 2) (2)

2.10 Categories of OHS:

Conditions. ✓

Actions ✓

(2)
[24]

QUESTION 3: TOOLS AND EQUIPMENT (GENERIC)

3.1 3.1.1 Pedestal bench grinder. ✓ (1)

3.1.2 A – Head / Motor ✓
B – Disc guard ✓
C – Maximum gap (3 mm) ✓
D – Grinding wheel ✓
E – Perspex shield ✓
F – Tool rest ✓ (6)

3.1.3 Perspex shield is to protect your eyes from the grinding debris. ✓ (1)

3.2 Manual guillotine:

A manual guillotine is designed to cut sheet metal that is not thicker than 1,2 mm. ✓

It is usually able to accommodate sheets not wider than 1,2 mm. ✓ (2)

3.3 Press machine:

Manual and hydraulic ✓✓ (2)

3.4 3.4.1 Function - Horizontal band saw:

It is to cut large metal sections ✓ in a horizontal position. ✓ (2)

3.4.2 Function – Power saw:

It is used to rough cut. ✓✓ (2)

[16]

QUESTION 4: MAINTENANCE (GENERIC)**4.1 Required drill speed:**

$$N = \frac{S}{\pi \cdot 25} \checkmark$$

$$= \frac{700}{78,55} \checkmark$$

$$= 8,91 \text{ r/s} \checkmark$$

(3)

4.2 Lack of lubrication on the chuck:

The moving parts that require lubrication should be oiled regularly to ensure free motion and prevent rust. ✓

(1)

4.3 Overloading:

It occurs when the drill bit is forced into the material at a rate that exceeds the rate at which the drill can cut and expel the cuttings. ✓

(2)

4.4 Causes of malfunction – Power saw:

Failure due to lack of lubrication. ✓

Incorrect lubrication to the oil in gearboxes and moving parts. ✓

(2)

[8]**QUESTION 5: MATERIALS (GENERIC)****5.1 5.1.1 Plasticity:**

It allows the material to change shape permanently. ✓

It is the reverse of elasticity. ✓

(2)

5.1.2 Ductility:

It allows the material to change shape by stretching it along its length without breaking or drawing it into wire form. ✓✓

(2)

5.1.3 Brittleness:

It causes the material to break easily ✓ and fractures may occur with little or no deformation. ✓

(2)

5.2 Iron age:

The prehistoric era 1500 – 1000 BC was known as the Iron Age. ✓

(1)

5.3 Operational function of blast furnace:

It is charged with alternative layers of iron ore, coke and limestone. ✓

The raw materials are supplied at the top of the furnace, through a hopper. ✓

The hot air from the stoves is blown through the nozzles. ✓

The nozzles are located near the base of the blast furnace. ✓

The carbon in the coke and the oxygen in the air combine to form a toxic carbon monoxide gas at a temperature of about 1648° C. ✓

This reduces the iron ore to metallic iron. ✓

(6)

5.4 5.4.1 Labels: Electric arc furnace:

- A – Charging ladle ✓
- B – Funnel ✓
- C – Scrap metal ✓
- D – Steel ✓
- E – Slag thimble ✓
- F – Charging machine ✓
- G – Charging boxes ✓

(7)

5.4.2 Function Electric arc furnace:

It is used for the production of stainless steel. ✓✓

(2)

5.5 Cold chisels:

Heat it to a bright red, about 75 mm from the point, then dip the point of the chisel in water. ✓ This must be just dipped, and moved up and down slightly to avoid a sharp line of demarcation between the hard and soft, ✓ which may, if it occurs, cause the hard end to shear off bodily then the chisel is put to use. ✓ As soon as the actual edge is quenched to cold, move the chisel rapidly to the anvil, lay the hard end across the edge to support it, and rub both sides with a stone. ✓ This brightens it sufficiently for the operator to see the temper colours as they appear, coming up in straight lines across the shank. ✓

(Any 4) (4)

5.6 Procedure:

Tempering ✓✓

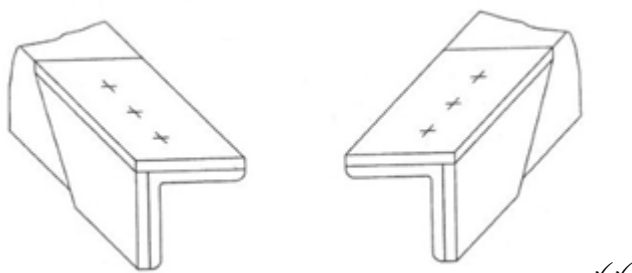
(2)

5.7 Difference between hardening and tempering:

Hardening is when you dunk red-hot metal into cold water, ✓✓ and tempering is when you take that hardened metal, heat it slightly, and then let it cool slowly. ✓✓

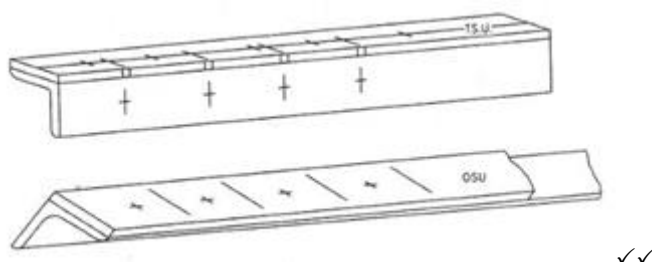
(4)

[32]

QUESTION 6: WELDING TERMINOLOGY (SPECIFIC)6.1 6.1.1 **Strip templates:**

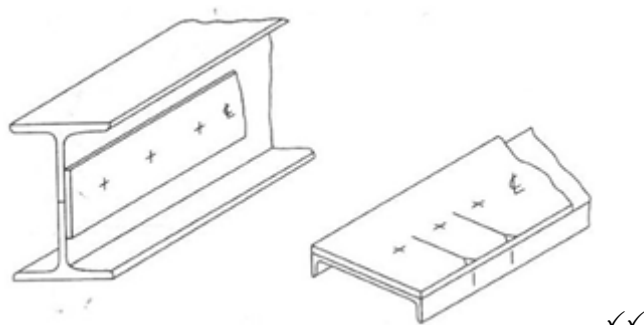
✓✓

(2)

6.1.2 **Flange template:**

✓✓

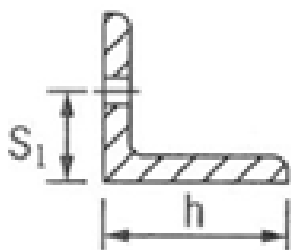
(2)

6.1.3 **Web templates:**

✓✓

(2)

6.2



✓✓

(2)

6.3 **Identification:**

6.3.1 A: Rise ✓

(1)

- 6.4 6.4.1 Rafter of truss:

$$\sqrt{Rafter^2} = \sqrt{2^2 + 6^2} \checkmark$$

$$= \sqrt{40} \checkmark$$
Rafter = 6,32 \checkmark (3)
- 6.4.2 Rafter angle:

$$\tan \emptyset = \frac{2}{6} \checkmark$$

$$= 0,332 \checkmark$$

$$\emptyset = 18,43^\circ \checkmark$$
 (3)
- 6.4.3 Slope:

$$\text{Slope} = \frac{2}{12} \checkmark$$

$$= \frac{1}{6} \checkmark$$

$$= 1 \text{ in } 6 \checkmark$$
 (3)
- [18]**

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

- 7.1 **Types of welding machines:**
AC machines \checkmark
Inverters (DC machines) \checkmark
MIG / GMAW / MAG (DC) \checkmark
TIG (AC OR DC) (Any 3) (3)
- 7.2 **Resistance welding / Spot welding:**
Resistance welding, or spot welding as it is commonly known, does not use a consumable electrode to deposit a weld bead, as it is the case with other forms of welding. \checkmark
This method uses the heating effect, which occurs when a current flows through a resistance, to fuse two plates together. \checkmark
Two copper electrodes are pressed together and a high electrical resistance passes between the electrodes, which causes intense heat, which join the metal. (Any 2) (2)
- 7.3 **Back firing:**
Back firing is the most hazardous aspect of oxy-acetylene welding. \checkmark
It occurs when either oxygen or acetylene gas flows towards the cylinder of the other gas. \checkmark
The danger is that the explosive mixture produced could ignite or explode. (Any 2) (2)
- [7]**

QUESTION 8: FORCES (SPECIFIC)

8.1 8.1.1 Stress = $\frac{\text{Load}}{\text{Cross Sectional Area}}$ ✓

$$= \frac{60 \times 10^3}{\frac{\pi \times (50)^2}{4 \times 10^6}} \checkmark$$

$$= \frac{4 \times 60 \times 10^9}{\pi(50)^2} \checkmark$$

$$= \frac{240 \times 10^9}{7855} \checkmark$$

$$= 30553787,4 \text{ Pa} \checkmark$$

OR

$$= 30,55 \text{ MPa} \quad (5)$$

8.1.2 **Change in length:**

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}} \checkmark$$

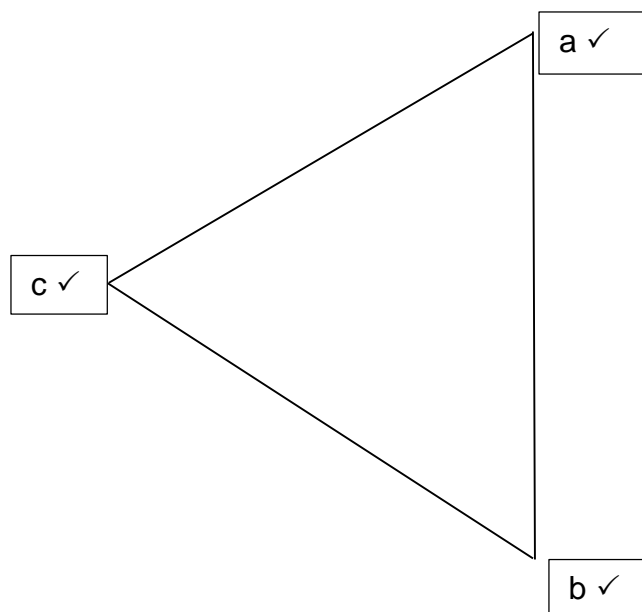
$$= \frac{0,4}{100} \checkmark$$

$$= 0,0004 \checkmark$$

OR

$$= 4 \times 10^{-4} \quad (3)$$

8.2



(3)

8.3 RL: $(RR \times 6) = (4 \times 1) + (5 \times 3) + (3 \times 5) \checkmark$

$$= 34 \checkmark$$

$$RR = 5,66 \text{ N} \checkmark$$

RR: $(RL \times 6) = (3 \times 1) + (5 \times 3) + (4 \times 5) \checkmark$

$$= 38 \checkmark$$

$$RL = 6,33 \text{ N} \checkmark$$

(6)
[17]

QUESTION 9: MAINTENANCE (SPECIFIC)

- 9.1 **Lack of lubrication:**
 It will damage moving components. ✓
 Free motion and prevent wear. ✓ (2)
- 9.2 **Results of overloading:**
 Cutting or punching steel that is thicker than the rated thickness will overload the machine, resulting in breaking the blades and strain the motor and drive mechanisms. ✓
 Punching steel with a die that is too small relative to the steel thickness will overload the punch and have wear effects. ✓ (2)
- 9.3 **Plant and equipment maintenance:**
 Ensure maintenance is carried out by a competent person. ✓
 Have a procedure that allows workers to report damaged or faulty equipment. ✓
 Provide the proper tools for the maintenance person.
 Schedule maintenance to minimise the risk to other workers and the maintenance person wherever possible.
 Make sure maintenance is done safely.
 Make sure that moving parts are isolated or locked.
 Make sure that flammable/explosive/toxic materials are dealt with properly.
 (Any 2) (2)
- [6]**

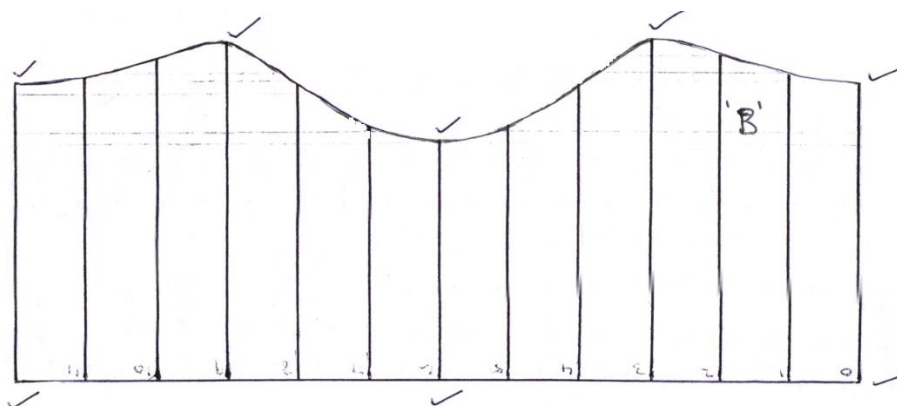
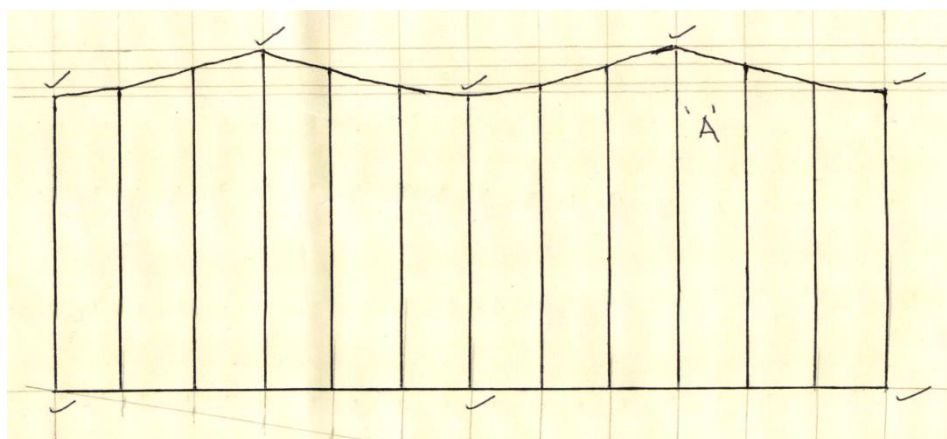
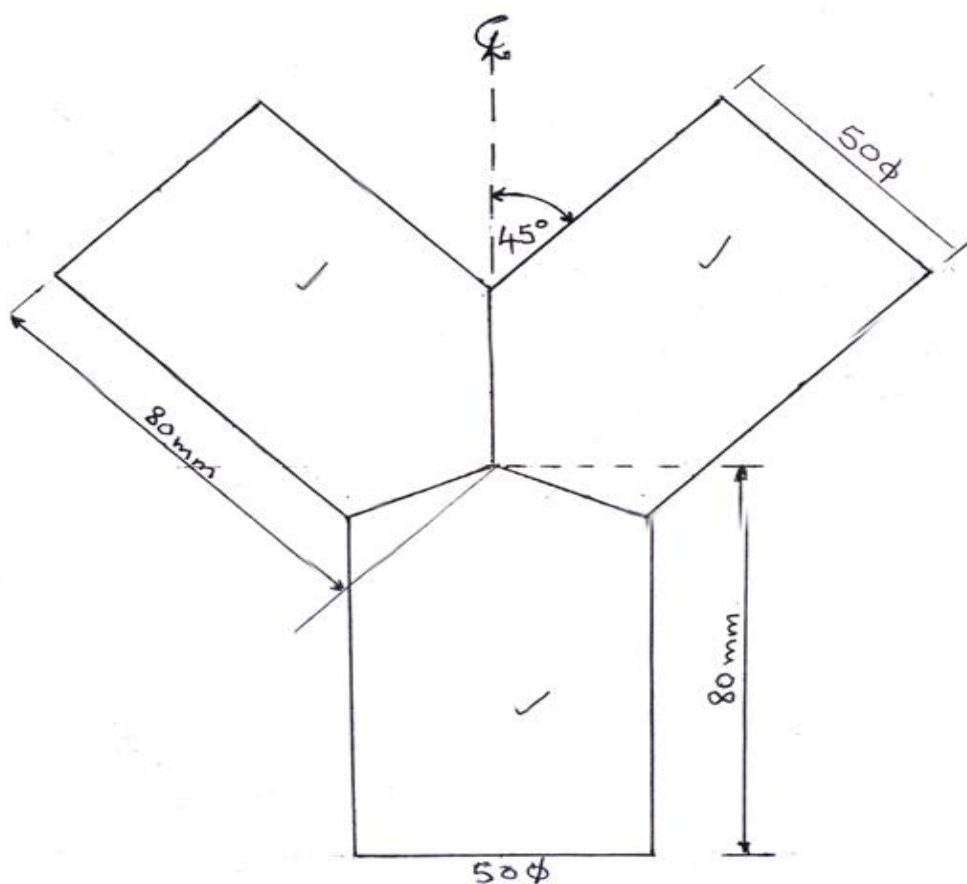
QUESTION 10: JOINING METHODS (SPECIFIC)

- 10.1 10.1.1 **Label A - E:**
- | | | |
|----------|-------------------------------|-----|
| A | Check in temperature rise ✓ | |
| B | Heating curve ✓ | |
| C | Uniform temperature rise ✓ | |
| D | Uniform fall in temperature ✓ | |
| E | Cooling curve ✓ | (5) |
- 10.1.2 **Methods of heat treatment:**
 Annealing ✓
 Normalising ✓
 Hardening ✓
 Tempering
 Case hardening (Any 3) (3)
- 10.2 **Carbon steel and content:**
 Low Carbon steel ✓ (up to 0,25 % carbon) ✓
 Medium Carbon steel ✓ (0,25 – 0,7% carbon) ✓
 High Carbon steel ✓ (0,7 – 0,15 % carbon) ✓ (6)
- 10.3 **Arc / gas welding defects:**
 Blow holes ✓
 Porosity
 Incomplete penetration
 Undercutting
 Weld craters
 Slag inclusion
 Cracks (Any 1) (1)

[15]

QUESTION 11: TERMINOLOGY DEVELOPMENTS (SPECIFIC)

11.1



(19)
[19]

QUESTION 12: TERMINOLOGY (STEEL SECTIONS) (SPECIFIC)**12.1 Different Steel sections:**

Flat bar ✓

Square bar ✓

Round bar ✓

Angle iron (equal leg / flange angle iron) ✓

Angle iron (unequal leg / flange angle iron)

(Any 4) (4)

12.2 Steel mill:

It is an industrial plant ✓ that manufactures steel. ✓

(2)

12.3 Notching:

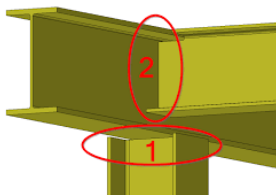
It is the process of cutting out a section of steel ✓ in order to form a snug fit with the flange of a corresponding section. ✓

(2)

12.4

✓✓✓✓

(4)

OR**12.5 Types of steel joints:**

12.5.1 Knee brace ✓

(1)

12.5.2 Gantry bracket ✓

(1)

12.5.3 Beam to beam connection. ✓

(1)

12.6 Type of cutting machine:

Plasma cutting machine ✓

(1)

12.7 Types of T-Joints:

I-Beam to I-Beam joint ✓

I-Beam to smaller I- Beam joint ✓

Channel iron to channel iron joint

Channel iron to smaller channel iron joint

(Any 2) (2)

[18]**TOTAL: 200**