Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2019

MECHANICAL TECHNOLOGY: WELDING AND METALWORK MARKING GUIDELINE

MARKS: 200

This marking guideline consists of 14 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

1.1 C ✓
1.2 B ✓
1.3 D ✓
1.4 C ✓
1.5 A ✓
1.6 B ✓
1.7 C ✓
1.8 A ✓
1.9 C ✓
1.10 B ✓
1.11 B ✓
1.12 D ✓
1.13 A ✓
1.14 A ✓
1.15 A ✓
1.16 B ✓
1.17 D ✓
1.18 C ✓
1.19 B ✓
1.20 B ✓ (20 x 1) **[20]**

QUESTION 2: SAFETY (GENERIC)

2.1 **Gas welding (PPE)**

- Eye protection ✓
- Overall / leather apron ✓
- Safety boots ✓
- Gloves ✓ (Any 3 x 1) (3)

2.2 **Hydraulic Press**

- The predetermined pressure must not be exceeded ✓
- Pressure gauges must be tested regularly ✓
- The platform on which the work piece rests must be rigid and square ✓
- The platform must rest on the supporting pins ✓
- Place objects to be pressed in or out of the suitable jigs ✓
- Special tools and holding devices must be used to prevent damage to soft material ✓
- Ensure that the direction of pressure is always 90° to the platform. ✓
- Relieve pressure after use by opening the return valve ✓ (Any 3 x 1) (3)

2.3 **Surface Grinder**

- Do not force the work piece into the wheel ✓
- Do not clean or adjust the machine while it is in motion ✓
- Avoid large cuts ✓
- Use coolant ✓
- Know how to use the emergency stop ✓
- Keep an eye on the position of the work piece ✓
- Keep all tools clear of the work table ✓
- Do not leave the machine while it is in operation ✓
- Do not lean on the machine ✓ (Any 3 x 1) (3)

2.4 Switch off the machine. ✓ (1)

2.5 **Bench Grinder**

- Make sure that there are no cracks or chips on the disc ✓
- Make sure that the emery disc that is fitted is rated above the revolutions at which it is turned by the motor ✓
- Make sure that the space between the tool rest and the emery disc does not exceed 3 mm ✓
- Ensure that guards are in place ✓
- When switching on the machine, do not stand in front of it until it reaches its full speed ✓
- Do not force or bump the work piece against the emery disc ✓
- Grind only on the front surface of the wheel not the sides ✓
- All grinding machines must have a sign indicating the revolutions which the spindle rotates ✓ (Any 3 x 1) (3)

2.6 To protect your eyes from flying sparks ✓ (1)

2.7 **Safety: Hand drill**

- Use a sharp drill of the right size for the type of material to be drilled. ✓
- Remove the key from the chuck. ✓
- Never leave the machine running unattended. ✓
- Clamp the work piece securely on the vice or table. ✓
- Never attempt to stop the machine with your hands if it slips. ✓
- Do not force the drill on the work piece. ✓
- Use a brush to remove chips from the drill. ✓ (Any 3 x 1) (3)

2.8 **Handling of gas bottles/cylinders**

- Ensure the cylinders are stored in an upright position ✓
- The cylinders should be colour-coded ✓
- Full cylinders should be separated from empty ones ✓
- Keep away from direct sunlight ✓
- Keep protector cap on for protection ✓ (Any 3 x 1) (3)

2.9 **Band saw**

- Ensure there is no oil or grease around the machine ✓
- Ensure that all guides are in place before work commences ✓
- Ensure that the entire blade is guarded except at the point to cut ✓
- Ensure that the machine is switched off when changing blades or guides
- Wear eye protection ✓
- Ensure that the blade is fitted in the correct cutting direction ✓
- Round material must be clamped in a vice or holding device ✓
- Always use pusher against the work piece whenever possible ✓

(Any 3 x 1) (3)

2.10 Clamp the work piece in the vice or holding device ✓ (1)

[24]

QUESTION 3: TOOLS AND EQUIPMENT (GENERIC)

3.1 **Function of tap and die set**

Tap is used to cut internal threads ✓ and die cuts external threads ✓ (2)

3.2 **Purpose of extension bar of guillotin**e

Lengthens the work surface and supports longer material ✓✓ (2)

3.3 A Pressure gauge ✓

B Handle ✓

C Hydraulic press cylinder ✓

D Supporting pin ✓

E Adjustment holes ✓

F Plunger ✓ (6)

3.4 **Functions of equipment**

3.4.1 Angle grinder - is used for cutting, grinding and polishing ✓✓ (2)

3.4.2 Rolling machine – used to roll sheet metal ✓✓ (2)

3.4.3 Press machine – press fit or remove parts from each other ✓✓ (2)

[16]

QUESTION 4: MAINTENANCE (GENERIC)

4.1 **Maintenance of pedestal grinder**
Guards- always check that they are clamped ✓ before operation and have adequate clearance ✓ from the rotating grinding wheel (6 mm) (2)

4.2 **Reducing friction when cutting holes**
Apply cutting fluid ✓
Apply oil to the tip of drill bit ✓ (2)

4.3 **Overloading** is when the lubrication bearer of oil is squeezed out of the machine-bearing surfaces ✓✓ (2)

4.4 **Lack of lubrication in a gear system**
- Without lubrication friction between teeth contact surfaces becomes too great, resulting in loss of efficiency ✓
- Excessive noise ✓
- Overheating ✓
- Eventual mechanical failure ✓ (Any 2 x 1) (2)

[8]

QUESTION 5: MATERIALS (GENERIC)

5.1 **Raw materials in the production of iron:**
- Iron ore ✓
- Fuel (coke) ✓
- Fluxing agent (lime stone) ✓
- Air ✓ (Any 3 x 1) (3)

5.2 **Blast furnace product**
Pig Iron ✓ (1)

5.3 **Electric-arc furnace**
It is useful in the production of stainless steel, other high-alloy steels, ✓ or special steels requiring very close metallurgical control ✓of grain or other structural qualities ✓ (3)

5.4 **Functions of furnaces**

5.4.1 **Blast Furnace:** It is used to convert iron ore to pig iron ✓✓ (2)

5.4.2 **Bessemer converter furnace**
It is used to convert molten pig iron to steel by the Bessemer process ✓✓ (2)

5.4.3 **Open hearth furnace**
It is used to convert scrap metal and other alloying elements into different kinds of steel ✓✓ (2)

5.5 5.5.1 Blast furnace ✓ (1)

5.5.2 A Small bell ✓
B Stack ✓
C Melting zone ✓
D Iron tap hole ✓
E Hot air supply hole from stove ✓
F Steel casing ✓
G Hopper / Load ✓ (7)

5.6 **Advantages of rotor plant**

- The molten metal is protected by a layer of slag ✓
- The oxidation of iron and other elements is minimised ✓
- The melting loss is lower than that of the cupola furnace ✓ (3)

5.7 **Properties of metals**

5.7.1 **Ductility** is the ability of a metal to change shape by stretching it along its length without breaking or drawing it into wire form ✓✓ (2)

5.7.2 **Brittleness** is the ability of a metal to break easily and fracture with little or no deformation ✓✓ (2)

5.7.3 **Plasticity** is the ability of a metal to change shape permanently. It is the reverse of elasticity ✓✓ (2)

5.7.4 **Toughness** is the ability of a metal to resist penetration, cracking, bending, breaking or stretching and remain intact after continual bending in opposite directions ✓ (2)

[32]

QUESTION 6: WELDING TERMINOLOGY (SPECIFIC)

6.1 **Roof truss**

It is a frame used to support a roof covering and to provide a structure which overhead cranes can be fixed ✓✓ (2)

6.2 **Roof truss calculations**

6.2.1 Pitch = $\frac{rise}{span}$

$= \frac{3000}{12000}$ ✓

$= \frac{1}{4}$ or (1 in 4) or 1 : 4 ✓ (2)

6.2.2 Slope = $\frac{rise}{part\ of\ span\ over\ which\ rise\ takes\ place}$

$= \frac{3000}{6000}$ ✓

$= \frac{1}{2}$ or (1 in 2)

= 1:2 ✓ (2)

6.2.3 Rafter length (C^2) = $A^2 + B^2$

$= 6^2 + 3^2$ ✓

$C = \sqrt{6^2 + 3^2}$

C = 6,7 m ✓ (2)

6.3 **Advantages of using a template**

- Cheap and easy to rectify mistakes ✓
- Ensures uniformity in production ✓
- Ensures accuracy and precision ✓
- Enables unskilled workers to use it relatively easy ✓ (Any 2 x 1) (2)

6.4 **Definition of terms**

6.4.1 Fusion zone is the portion of the weld where the parent metal has been fused ✓✓ (2)

6.4.2 Weld metal is part of the metal of a welded joint that has been melt during its formation ✓✓ (2)

6.5 **Supplementary symbols**

6.5.1 M – Machine ✓

6.5.2 G – Grind ✓ (2)

6.6 **Methods of reducing distortion**

- Skip welding method ✓
- Alternate welding method ✓
- Back step welding ✓ (Any 2 x 1) (2)

[18]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

7.1 **Purpose of oxy-acetylene regulators**

- To indicate the pressure inside the cylinders ✓
- To reduce the cylinder pressure to working pressure ✓ (Any 1 x 1) (1)

7.2 **Rolling machine used for bending thick plate**

- Vertical roll ✓ (1)

7.3 **Use of a guillotine**

- To cut sheet metal ✓
- To cut plate metal ✓ (Any 1 x 1) (1)

7.4 **Function of punching machine**

- To cut steel profiles ✓
- To punch holes into steel plates ✓ (2)

7.5 **Reasons why plasma cutter is preferred to oxy-acetylene**

- High speed ✓
- Precision cutting ✓
- Low cost ✓
- Cuts thin and thick materials ✓
- Cuts smoothly ✓ (Any 2 x 1) (2)

[7]

QUESTION 8: FORCES (SPECIFIC)

8.1

	8.1.1	8.1.2
FORCES	**HORIZONTAL COMPONENTS**	**VERTICAL COMPONENTS**
45 N	45 Cos 0 = 45N ✓	45 Sin 0 = 0
50 N	50Cos 90 = 0	50 Sin 90 = **50 N** ✓
30 N	30Cos45 OR 30 Cos135 = **-21,21N** ✓	30 Sin 45 OR 30 Sin 135 = **21,21N**✓
TOTAL	**23,79 N** ✓	**71,21 N** ✓

(6)

8.2 **Take moments about RR**

LR x 8 m = (20 x 6 m) + (30 x 4 m) ✓
8LR = 120 + 120 ✓
LR = 30 N ✓

Take moments about LR

RR x 8 m = (30 x 4 m) + (20 x 2 m) ✓

8RR = 120 + 40 ✓

RR = 20 N ✓ (6)

8.3 Stress = $\frac{Force}{Area}$

Area = $\frac{\pi\,(D^2-d^2)}{4}$ ✓

= $\frac{\pi(0{,}025^2-0{,}021^{2)}}{4}$ ✓

= 1,445133 x $10^{-4}\ m^2$ ✓

Stress = $\frac{10\ \text{x}10^3}{1{,}445133\text{x}\ 10^{-4}}$ ✓

= 69197801, 34 Pa

= 69, 2 MPa ✓ (5)

[17]

QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Effects of overloading rolling machine**

Limits the life span of components (bearings, gearbox, motor) ✓✓ (2)

9.2 **Prevent excessive wear**

The specified lubricant is to be applied to the relevant lubricating point in a specified quantity and at a specific time ✓ (1)

9.3 **Lack of lubrication – Punch and shear machine**

Components (moving parts) will cause excessive wear and result in the journals seizing in the bearings/bushes ✓✓ (2)

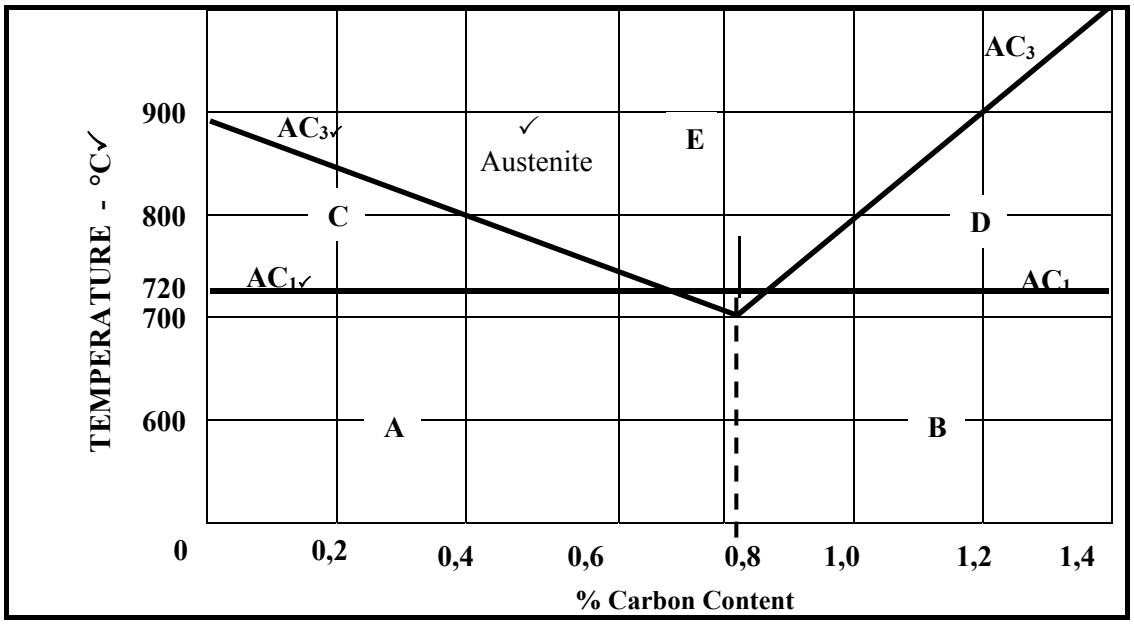
9.4 **Friction not a relevant factor in machine**

- Guillotine ✓
- Punch ✓ (Any 1 x 1) (1)

[6]

QUESTION 10: JOINING METHODS (SPECIFIC)

10.1



(5)

10.2 **Purpose of normalising**
To soften steel above its critical range and to cool it in still air ✓✓ (2)

10.3 **MIGS** – Metal inert gas shielded ✓ (1)

10.4 **Undercutting**

Causes

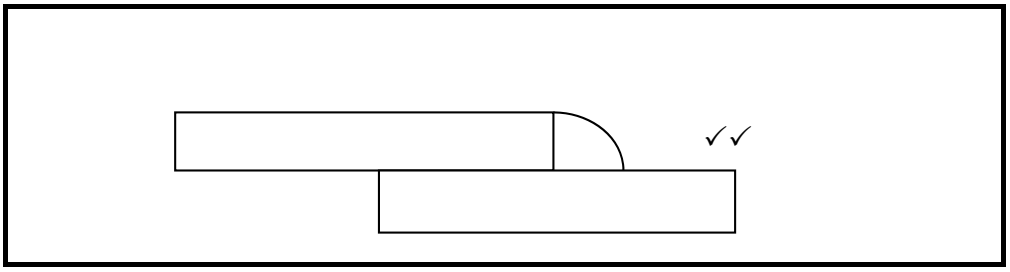
- Faulty electrode manipulation ✓
- Current too high ✓
- Arc length too long ✓
- Speed of weld too fast ✓
- Improper welding parameters ✓ (Any 1 x 1) (1)

Remedies

- Do not use too large electrodes ✓
- Use moderate current ✓
- Hold electrode at correct angle ✓ (Any 1 x 1) (1)

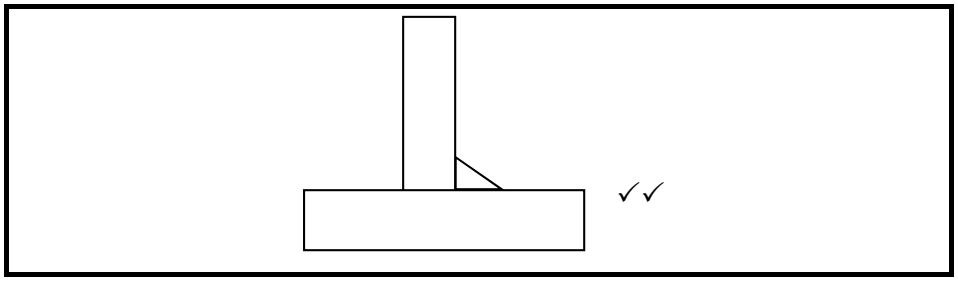
10.5 **Welding joints**

10.5.1



(2)

10.5.2



(2)

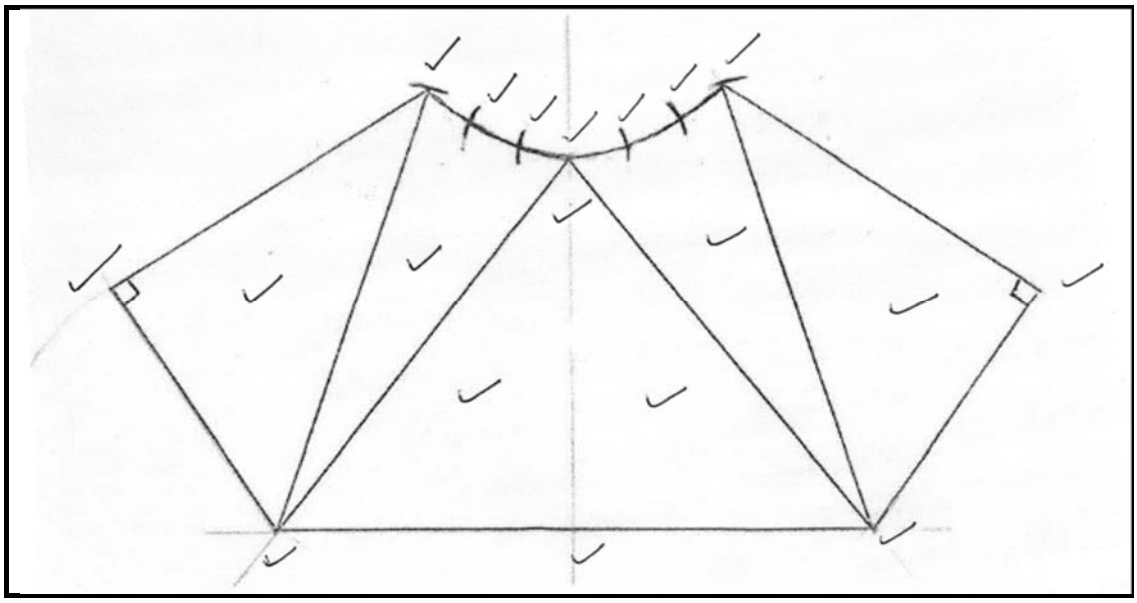
10.6 **Inert gases for MIG/MAGS welding:**

- CO_2 ✓
- Argon ✓
- Helium ✓
- Teral (Argon + CO_2) ✓ (Any 1 x 1) (1)

[15]

QUESTION 11: SYSTEMS AND CONTROLS (SPECIFIC)

11.1 Develop the square to round transition piece shown in FIGURE 11.1.



(9)
[19]

QUESTION 12: TERMINOLOGY (STEEL SECTIONS) (SPECIFIC)

12.1 **Steel bars**

12.1.1

Square Bar ✓✓ (2)

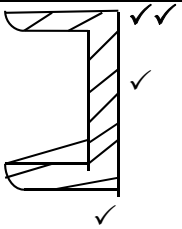
12.1.2

Flat Bar ✓✓ (2)

12.2 **Purpose of an assembly jig**

To hold parts in position ✓ so that a number of identical items can be tack welded and easily removed before final welding is done ✓ (2)

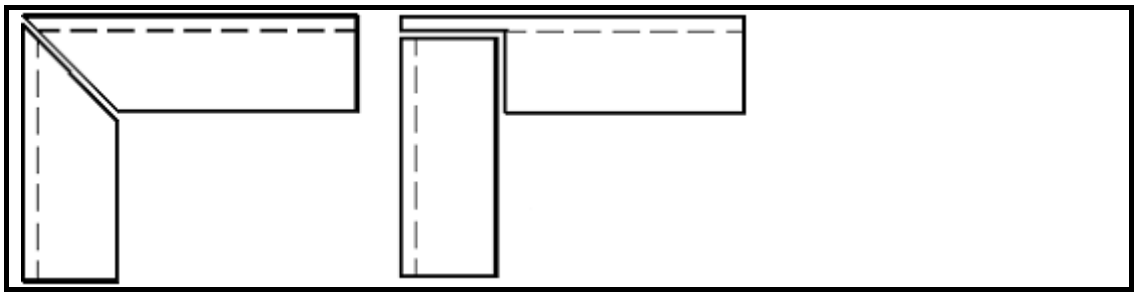
12.3 **Channel iron**



✓✓
✓
✓

(4)

12.4 **TWO preparation methods**



Methods of the ends of two equal angle iron bars that have to be welded at 90° to each other (4)

12.5 **I- Beam** is a rolled steel joist (RS) that is used in heavier, structural steel construction ✓✓ (2)

12.6 **Disadvantage of welding steel section**

Components are permanently joined and sometimes difficult to transport due to size constrains ✓✓ (2)

[18]

TOTAL: 200