

Need an amazing tutor?

www.teachme2.com/matric



Collected and collated by

teachme2



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MECHANICAL TECHNOLOGY: WELDING AND METALWORK

2023

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 21 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

- | | | |
|-----|-----|------------|
| 1.1 | C ✓ | (1) |
| 1.2 | A ✓ | (1) |
| 1.3 | A ✓ | (1) |
| 1.4 | C ✓ | (1) |
| 1.5 | B ✓ | (1) |
| 1.6 | A ✓ | (1) |
| | | [6] |

QUESTION 2: SAFETY (GENERIC)**2.1 Safety rule after the work procedures:**

Switch off the machine. ✓

(1)

2.2 Space between the tool rest and the emery wheel:

- To prevent the work piece from jamming between the wheel and tool rest. ✓
- Prevents the wheel from being damaged. ✓
- Prevents the work piece from being damaged. ✓
- Prevent injury. ✓

(Any 2 x 1) (2)**2.3 Workshop layouts:**

2.3.1 Process layout. ✓

(1)

2.3.2 Product layout. ✓

(1)

2.4 Hydraulic press:

- Safety goggles ✓
- Safety gloves ✓
- Safety shoes ✓
- Overall ✓

(Any 1 x 1) (1)**2.5 Safety guard on the portable angle grinder:**

- To protect one against sparks/metal particles. ✓
- To protect one from a breaking disc. ✓
- To protect your hand from coming into contact with the disc. ✓

(Any 1 x 1) (1)**2.6 Shearing/Guillotine machine:**

- Follow the manufactures recommendations. ✓
- Keep hands away from action points. ✓
- Do not exceed the maximum material thickness. ✓
- Ensure that all guards are in place and secure. ✓
- Report defects immediately. ✓

(Any 1 x 1) (1)

2.7 **Storing gas cylinders:**

- Upright position ✓
- Stored at 20°C / cool area ✓
- Empty cylinders stored separately from full cylinder. ✓
- Never store cylinders on top of each other. ✓
- Oxygen cylinders separate from fuel cylinders. ✓
- Secure gas cylinders. ✓
- Ensure that cylinders are properly closed. ✓
- Stored away from sparks / flammable material/ electrical switches. ✓
- Stored in a well-ventilated area. ✓
- Safety signs should be displayed. ✓
- Keep cylinders clearly labelled (Full/Empty). ✓

(Any 2 x 1)

(2)

[10]

QUESTION 3: MATERIALS (GENERIC)**3.1 Purpose of tempering:**

- To relieve ✓ strain / brittleness. ✓
- To increase ✓ the toughness of the steel. ✓
- To refine ✓ grain structure. ✓

(Any 1 x 2) (2)**3.2 Heat treatment processes:****3.2.1 Case hardening:**

- To obtain a wear-resistant surface ✓ and at the same time be tough enough internally at the core ✓ to withstand the applied loads.
- For a hard case ✓ over a tough core. ✓

(Any 1 x 2) (2)**3.2.2 Annealing:**

- To relieve ✓ internal stresses. ✓
- To soften ✓ steel. ✓
- Facilitate ✓ the machining processes. ✓
- Increase ✓ the steel's ductility. ✓
- Reduce ✓ brittleness. ✓

(Any 1 x 2) (2)**3.3 Spark test:**

- Hold steel against grinding wheel. ✓
- Observe the spark pattern to identify the type of steel. ✓

(2)**3.4 Tests:****3.4.1 Filing test:**

File on the tip or near the edge ✓ of the material. The bite will determine the hardness. ✓

(2)**3.4.2 Bend test:**

- Metal is subjected to deformation by bending. ✓
- Observe the rupture of the metal. ✓

(2)**3.5 Sound test on steel:****3.5.1 Low carbon steel (LCS):**

Dull (low pitch) ✓ sound.

(1)**3.5.2 High carbon steel (HCS):**

Loud and clear (high pitch) ✓ sound.

(1)**[14]**

QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)

4.1	C ✓	(1)
4.2	B ✓	(1)
4.3	A ✓	(1)
4.4	B ✓	(1)
4.5	D ✓	(1)
4.6	D ✓	(1)
4.7	B ✓	(1)
4.8	D ✓	(1)
4.9	C ✓	(1)
4.10	A ✓	(1)
4.11	C ✓	(1)
4.12	A ✓	(1)
4.13	D ✓	(1)
4.14	B ✓	(1)
		[14]

QUESTION 5: TERMINOLOGY(TEMPLATES) (SPECIFIC)

- 5.1
- Roof covering ✓ is attached ✓ to the purlins.
 - Purlins contribute to the rigidity ✓ and correct spacing ✓ of the rafters/structure.
- (Any 1 x 2) (2)
- 5.2 **Types of weld symbols:**
- 5.2.1 Site weld ✓ (1)
- 5.2.2 Surfacing ✓ (1)
- 5.2.3 U butt weld ✓ (1)
- 5.2.4 Seam weld ✓ (1)
- 5.3 Strip templates are used for longer sections of angle iron. ✓ (1)
- 5.4 **Dimensions of the material:**
- 5.4.1 **Mean diameter:**
- Mean Ø = Inside Ø + Thickness
- = 180 + 12 ✓
- = 192 mm ✓ (2)
- 5.4.2 **Mean circumference:**
- Mean circumference = $\pi \times \text{Mean } \varnothing$
- = $\pi \times 192 \text{ mm}$ ✓
- = 603,186 mm ✓
- Round off to 603 mm ✓ (3)
- 5.5 **Welding symbols:**
- Fillet weld both sides ✓
 - 8 mm in size ✓
 - Length of weld bead is 50 mm ✓
 - Pitch of weld is 100 mm ✓ (4)

5.6 **Roof truss:**

- A- Purlins ✓
- B- Ridging ✓
- C- Roof covering ✓
- D- Rafter ✓
- E- Internal bracing member ✓

(5)

5.7 **Lattice beams:**

- Tends to be very rigid. ✓✓
- Gives good strength to weight ratios over long spans. ✓✓

(Any 1 x 2)

(2)

[23]

QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)**6.1 Bench grinder uses:**

- Sharpening of tools ☐
- Shaping of metal ☐
- Remove unwanted material ☐
- Remove rough edges (burrs) ☐
- Grinding prior to welding of work piece ☐
- Used in conjunction with wire brush wheel to remove rust ☐
- Used in conjunction with buffing wheel to polish work piece ☐

(Any 3 x 1) (3)**6.2 MIG:**Metal inert gas ☐

(1)

6.3 Plasma cutter:

- The cutter sends an electrical channel of ionized gas through the work piece being cut. ☐
- It forms a complete electric circuit via a grounding clamp. ☐
- Compressed air is blown towards the work piece through a focused nozzle at high speed. ☐
- An electric arc is formed between the gas nozzle and the work piece. ☐

(4)

6.4 Types of taps:

- Taper tap / first tap ☐
- Intermediate tap / second tap ☐
- Plug tap / bottoming tap ☐

(3)

6.5 Removing slag:

- Chipping hammer ✓
- Wire brush ✓

(Any 1 x 1) (1)**6.6 Vertical rollers:**

Used solely for bending / rolling thick, heavy plates. ✓

(1)

6.7 Horizontal band saw:

- Ensures clean cut. ☐
- Removes shavings / cuttings. ☐
- Blade life span is prolonged. ☐
- Cools the blade. ☐
- Cools the metal. ☐

(Any 2 x 1) (2)

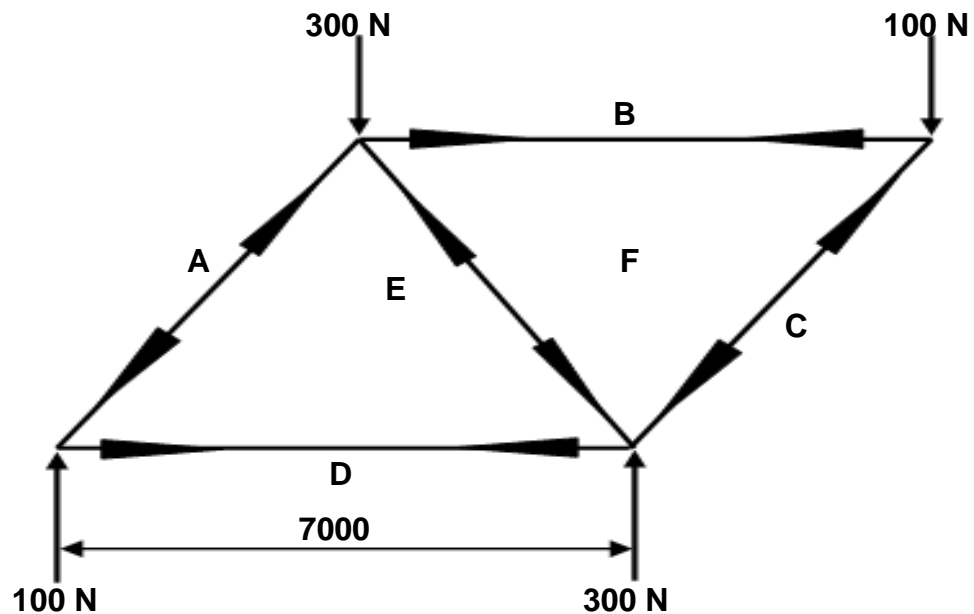
6.8 **Oxy-acetylene equipment - processes:**

- Gas welding ✓
- Brazing ✓
- Silver soldering ✓
- Heating / Melting ✓
- Cutting ✓
- Gouging ✓

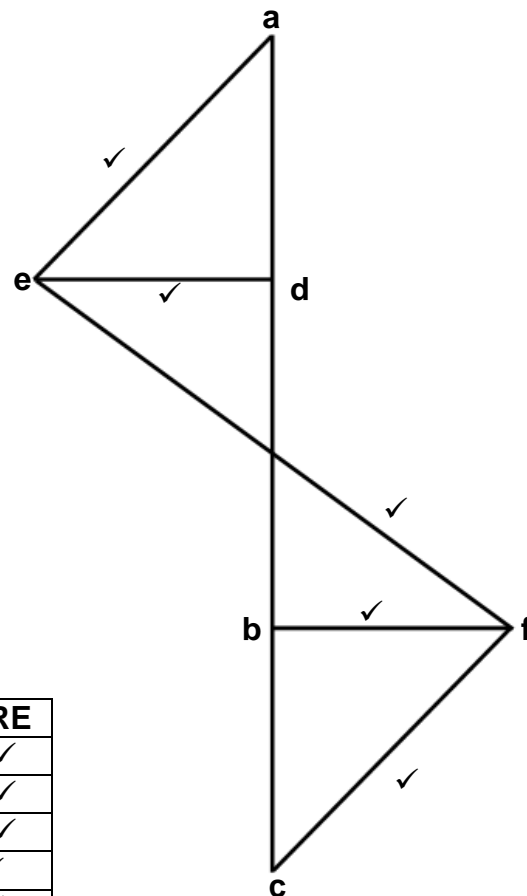
(Any 3 x 1)

(3)

[18]

QUESTION 7: FORCES (SPECIFIC)**7.1 Frameworks:****Note to marker:**

Marker must redraw the space and force diagram according to given scales for marking purposes. Tolerance of ± 2 mm



MEMBER	FORCE (N)	NATURE
AE	140 N ✓	Strut ✓
EF	285 N ✓	Strut ✓
FC	140 N ✓	Strut ✓
BF	100 N ✓	Tie ✓
ED	100 N ✓	Tie ✓

(15)

7.2 Beams:**7.2.1 Calculate RL:
Moments about RR:**

$$RL \times 10 = (8 \times 8) + (4 \times 5) + (6 \times 2)$$

$$RL = \frac{96}{10}$$

$$RL = 9,6 \text{ kN} \checkmark$$

(4)

**7.2.2 Calculate RR:
Moments about RL:**

$$RR \times 10 = (6 \times 8) + (4 \times 5) + (8 \times 2)$$

$$RR = \frac{84}{10}$$

$$RR = 8,4 \text{ kN} \checkmark$$

(4)

7.2.3 Bending moment:

Moment at:

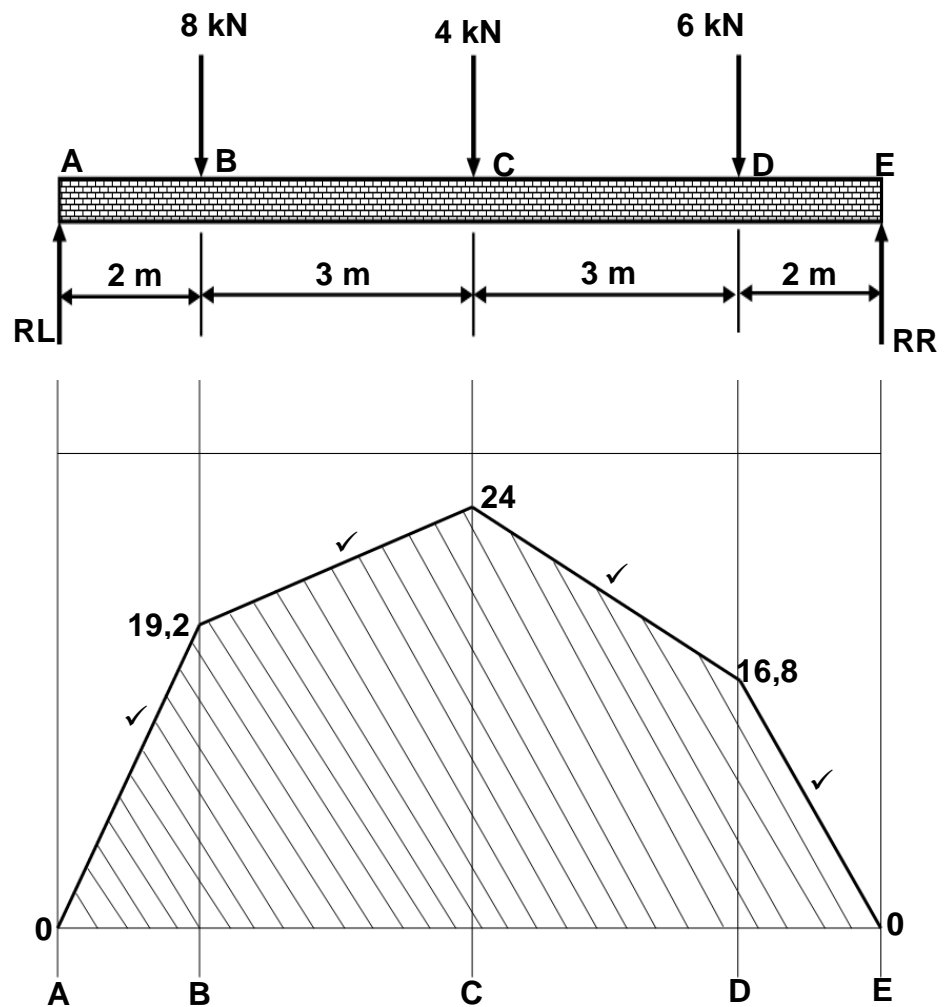
$$\mathbf{B:} \quad 9,6 \times 2 = 19,2 \text{ kN.m} \checkmark$$

$$\mathbf{C:} \quad (9,6 \times 5) - (8 \times 3) = 24 \text{ kN.m} \checkmark$$

$$\mathbf{D:} \quad (9,6 \times 8) - (8 \times 6) - (4 \times 3) = 16,8 \text{ kN.m} \checkmark$$

(6)

7.2.4 Bending-moment diagram:

**Note to marker:**

Marker must redraw the bending-moment diagram according to given scales for marking purposes.

(4)

7.3 Stress and strain:**7.3.1 Cross sectional area m²:**

$$\begin{aligned}
 A &= \frac{\pi D^2}{4} \\
 &= \frac{\pi \times 0,03^2}{4} \checkmark \\
 &= 0,71 \times 10^{-3} \text{ m}^2 \checkmark
 \end{aligned}
 \tag{2}$$

7.3.2 Stress MPa:

$$\begin{aligned}
 \text{Stress} &= \frac{\text{Load}}{\text{Area}} \\
 &= \frac{80 \times 10^3}{0,71 \times 10^{-3}} \checkmark \\
 &= 112676056,3 \text{ Pa} \\
 &= 112,68 \text{ MPa} \checkmark
 \end{aligned}
 \tag{3}$$

7.3.3 Strain:

$$\begin{aligned}
 \text{Strain} &= \frac{\Delta L}{OL} \\
 &= \frac{0,06}{3000} \checkmark \\
 &= 0,00002 \quad \text{OR} \quad 2 \times 10^{-5} \checkmark
 \end{aligned}
 \tag{2}$$

7.3.4 Young's modulus of elasticity:

$$\begin{aligned}
 E &= \frac{\text{Stress}}{\text{Strain}} \\
 &= \frac{112,68 \times 10^6}{2 \times 10^{-5}} \checkmark \quad \text{OR} \quad = \frac{112,68 \times 10^6}{2 \times 10^{-5}} \checkmark \\
 &= 5,633802815 \times 10^{12} \text{ Pa} \quad = 5,634 \times 10^{12} \text{ Pa} \\
 &= 5633,80 \times \text{GPa} \checkmark \quad = 5634 \text{ GPa} \checkmark
 \end{aligned}
 \tag{3}$$

7.4 Maximum stress:

$$\begin{aligned}
 \text{Stress} &= \frac{\text{Load}}{\text{Area}} \\
 &= \frac{55 \times 10^3}{0,9 \times 10^{-5}} \checkmark \\
 &= 6111111111 \text{ Pa} \checkmark \\
 &= 6111,11 \text{ MPa}
 \end{aligned}
 \tag{2}$$

[45]

QUESTION 8: JOINING METHODS (INSPECTION OF WELD) (SPECIFIC)**8.1 Visual inspection:**

- Shape of the profile ✓
- Uniformity of the surface ✓
- Overlap ✓
- Undercutting ✓
- Penetration bead ✓
- Root groove ✓
- Fusion ✓
- Reinforcement ✓
- Porosity ✓
- Spatter ✓
- Slag inclusions ✓
- (ANY WELD DEFECT THAT CAN BE SEEN VISUALLY AFTER WELDED) ✓

(Any 2 x 1) (2)**8.2 Free bend test:**

- Ductility ✓
- Brittleness ✓
- Malleability ✓
- Elongation ✓
- Elasticity ✓

(Any 1 x 1) (1)**8.3 Weld defect:**

Weld defect is a result which does not meet ✓ the prescribed requirements of a welded joint. ✓

(2)**8.4 Causes of welding defects:****8.4.1 Undercutting:**

- Current too high ✓
- Current too low ✓
- Wrong electrode angle ✓
- Arc length too long ✓
- Weld speed too fast ✓
- Too low arc voltage ✓
- Faulty electrode manipulation ✓

(Any 2 x 1) (2)

8.4.2 Blow hole:

- Presence of contaminants / impurities on the job surface or on electrode flux ✓
- Presence of high sulphur in the job or electrode materials ✓
- Lack of shielding gas ✓
- Using wet electrode ✓

(Any 2 x 1) (2)**8.5 Destructive tests:**

- Machinability test ✓
- Nick break test ✓
- Free bend test ✓
- Guided bend test ✓

(Any 2 x 1) (2)**8.6 Procedure for conducting X-ray test:**

- The photographic film is sealed in an envelope (so that the light cannot expose it) and placed behind the object being tested. ✓
- The X-ray or gamma ray source is placed in front of the object being tested. ✓
- The tester should stand behind lead shields and far away from possible harmful exposure. The source is activated for a brief moment and the X-rays penetrate the test piece. ✓
- As they pass through the areas of lower density, the rays expose the defect on the film as a lighter colour on the negative, ✓ indicating a weld defect. ✓
- Photographic films provide a permanent record of the shadow which can be carefully studied. / Shown on a monitor screen ✓

(6)**8.7 Types of dye:**

- Fluorescent dye ✓
- Brightly coloured dye ✓

(2)**8.8 Internal weld defects:**

- Cracks ✓
- Slag inclusion ✓
- Lack of fusion ✓
- Lack of root penetration ✓
- Blow hole ✓
- Porosity ✓

(Any 2 x 1) (2)**8.9 Centreline cracks:**

- Use the correct width to depth ratio. ✓
- Decreasing the current to decrease excess penetration. ✓
- Decreasing welding/arc voltage. ✓

(Any 2 x 1) (2)**[23]**

QUESTION 9: JOINING METHODS (STRESSES AND DISTORTION) (SPECIFIC)**9.1 Distortion and residual stress:**

- If the expansion that occurs when metal is heated is resisted then distortion will occur. ✓
- When contraction that occurs on cooling is resisted then a stress will be applied. ✓
- If the applied stress causes movement then distortion occurs. ✓
- If the applied stress does not cause movement then there will be residual stress in the welded joint. ✓

(Any 2 x 1) (2)**9.2 Shrinkage:**

Shrinkage is a form of plastic deformation where the metal has deformed ✓ as a result of contraction on cooling. ✓

(2)**9.3 Grain size:**

- The prior amount of cold work ✓
- The temperature and time of the annealing process ✓
- The composition ✓
- The melting point ✓

(Any 2 x 1) (2)**9.4 Cold working and hot working:**

- Cold working is when deformation ✓ of steel takes place below the recrystallisation temperature (AC_1) ✓ of the steel.
- Hot working is when deformation ✓ of steel takes place above the recrystallisation temperature (AC_1) ✓ of the steel.

(4)**9.5 Distortion:**

- Do not over weld. ✓
- Apply intermittent welding. ✓
- Place welds near the neutral axis. ✓
- Use as few passes as possible. ✓
- Use back-step welding. ✓
- Anticipate the shrinkage forces. ✓
- Plan the welding sequence. ✓
- Use strong backs. ✓
- Use clamps, jigs and fixtures. ✓

(Any 4 x 1) (4)

9.6 **Types of distortion:**

9.6.1 Longitudinal distortion ✓ (1)

9.6.2 Angular distortion ✓ (1)

9.7 **Metal is cooled rapidly:**

Rapid cooling of metal results in large temperature differences that set up stresses, ✓ which cause cracks on the surface. ✓ (2)

[18]

QUESTION 10: MAINTENANCE (SPECIFIC)**10.1 Maintenance definition:**

Precautionary measures, actions and processes ✓ that are taken to keep a machine or process ✓ in a functional order. ✓ (3)

10.2 Pedestal drilling machine:

- Visual checks of electrical wiring, switches. ✓
- Verify that all guards are secure and function correctly. ✓
- Lubricate moving parts. ✓
- Use moisture-penetrating oil spray to prevent rust. ✓
- Check for availability of specific tools. ✓
- Check the run-out of the spindle. ✓
- Inspect drive belts for wear. ✓
- Ensure the drive belt is correctly tensioned. ✓
- Check the condition of the rack and pinion mechanisms and lubricate. ✓
- Ensure cuttings are removed. ✓
- Inspect the Morse taper sleeves for burrs/scratches. ✓
- Check the chuck is correctly fitted and tight. ✓

(Any 2 x 1) (2)

10.3 Tagging plates:

- It is to isolate switches of machines before maintenance is undertaken. ✓
- To show workers that maintenance is being carried out on a specific machine. ✓

(Any 1 x 1) (1)

10.4 Service records:

- Assist in the monitoring of the condition of the machines. ✓
- Assist in upholding warranties. ✓
- Assist in keeping a history of maintenance and repairs. ✓

(Any 2 x 1) (2)
[8]

QUESTION 11: TERMINOLOGY (DEVELOPMENTS) (SPECIFIC)**11.1 Hopper:**

11.1.1 Square ✓ to rectangle ✓ on centre. ✓ (3)

11.1.2 (a) **A-1:**

$$\begin{aligned}
 A-1 &= \sqrt{100^2 + 125^2 + 450^2} \quad \checkmark \\
 &= \sqrt{228125} \\
 &= 477,62 \text{ mm} \quad \checkmark
 \end{aligned}
 \quad (2)$$

(b) **A-2:**

$$\begin{aligned}
 A-2 &= \sqrt{400^2 + 125^2 + 450^2} \quad \checkmark \\
 &= \sqrt{378125} \\
 &= 614,92 \text{ mm} \quad \checkmark
 \end{aligned}
 \quad (2)$$

(c) **B-3:**

$$\begin{aligned}
 B-3 &= \sqrt{375^2 + 100^2 + 450^2} \quad \checkmark \\
 &= \sqrt{353125} \\
 &= 594,24 \text{ mm} \quad \checkmark
 \end{aligned}
 \quad (2)$$

11.2 Cone frustum:11.2.1 **A-B:**

$$\begin{aligned}
 A-B &= \frac{\pi \times D}{12} \quad \checkmark \\
 &= \frac{\pi \times 800}{12} \quad \checkmark \\
 &= 209,44 \text{ mm} \quad \checkmark
 \end{aligned}
 \quad (3)$$

11.2.2 **O-1:**

$$\begin{aligned}
 O-1 &= \frac{\pi \times d}{12} \quad \checkmark \\
 &= \frac{\pi \times 600}{12} \quad \checkmark \\
 &= 157,08 \text{ mm} \quad \checkmark
 \end{aligned}
 \quad (3)$$

11.2.3 **A-0:****Plan length / base line:**

$$\begin{aligned} A-0 &= 400 - 300 \quad \checkmark \\ &= 100 \text{ mm} \quad \checkmark \end{aligned}$$

True length:

$$\begin{aligned} A-0 &= \sqrt{100^2 + 500^2} \quad \checkmark \\ &= \sqrt{260\,000} \\ &= 509,90 \text{ mm} \quad \checkmark \end{aligned}$$

(4)

11.3 **Square to round transformer:**Use to connect ducting sections \checkmark of dissimilar shapes to each other. \checkmark

(2)

[21]**TOTAL: 200**