LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

MECHANICAL TECHNOLOGY: WELDING AND METALWORK

NOVEMBER EXAMINATION – 2022

GRADE 11

MARKS: 200

TIME: 3 hours

This paper consists of 16 pages, 1 formula-page, and an ANNEXTURE.

INSTRUCTIONS AND INFORMATION

1. Write your NAME & SURNAME on the ANSWER BOOK.
2. Read ALL the questions carefully.
3. Answer ALL the questions.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Start EACH question on a NEW page.
6. Show ALL calculations and units. Round off final answers to TWO decimal places.
7. Candidates may use non-programmable scientific calculators and drawing instruments.
8. All dimensions are in millimetres, unless stated otherwise in the question.
9. Write neatly and legibly.
10. A formula sheet is attached at the end of the question paper.
11. Use the criteria below to assist with time management:

QUESTION	CONTENT	MARKS	TIME (minutes)
SECTION A - GENERIC			
1	Multiple Choice	8	8
2	Safety	10	9
3	Materials	14	11
SECTION B – SPECIFIC			
4	Multiple Choice	12	10
5	Terminology	27	24
6	Tools	20	18
7	Forces	35	32
8	Maintenance	15	14
9	Joining Methods	25	23
10	Terminology (Developments)	16	15
11	Terminology (Sections)	18	16
	Total:	**200**	**180**

SECTION A – GENERIC

QUESTION 1 - MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.8) in your ANSWER BOOK, for example 1.9 A

1.1 The Occupational Health and Safety Act:

A. Contains all the basic human rights applicable to the people of South Africa.
B. Emphasises the working relationship of employees and employers.
C. Explains the minimum standards that employers can expect from one another in the workplace.
D. States that all employers must make sure that the workplace is safe. (1)

1.2 Which ONE of the following Examination Procedures is applicable to Vital Functions?

A. Remove danger; move injured person; determine vital functions; move for thorough examination.
B. Breathing irregularities, limb breakages, bleeding, etc.
C. Presence of items to give indication of potential injuries sustained.
D. Breathing, heart rate, etc.; manner of speech/response also gives indication of the person's condition. (1)

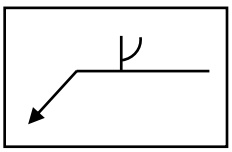
1.3 A drill machine carries out a specific process. Choose the correct option.

A. Grinding
B. Cutting
C. Shearing
D. Joining (1)

1.4 Which ONE of the following describes a workshop layout?

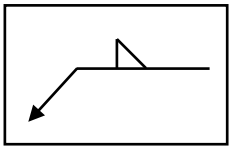
A. Process layout
B. Drill Layout
C. Inspection Layout
D. Receiving Layout (1)

1.5 Which weld symbol is in the image below?



A. Square I - weld
B. J - butt weld
C. Bevel half V - weld
D. Fillet weld (1)

1.6 Which weld symbol is in the image below?



A. Square I - weld
B. Spot weld
C. Bevel half V - weld
D. Fillet weld (1)

1.7 What do you call the structure in the image below?

A. Plate girder
B. Lattice beam
C. Roof truss
D. Cross-bracing (1)

1.8 What colour is an acetylene gas cylinder?

A. Black
B. Red
C. Green
D. Maroon

[8]

QUESTION 2 – SAFETY (GENERIC)

2.1 What is the definition of an accident? (4)

2.2 Name ONE example of an unsafe condition. (1)

2.3 What does PPE stand for? (1)

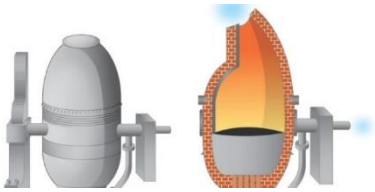
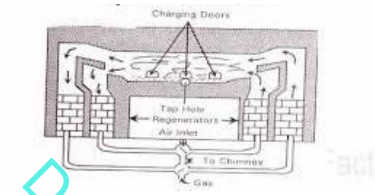
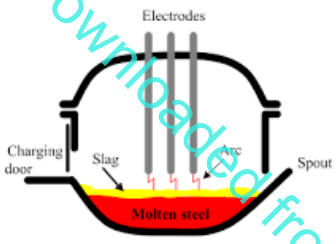
2.4 Give two reasons why is it important to wear a welding helmet during arc welding. (2)

2.5 Provide TWO safety precautions before using a drill press. (2)

[10]

QUESTION 3 - MATERIALS

3.1 Match the options in Column A with the options in Column B. There are eight answers.

A.		B.
3.1.1		A. Blast Furnace
3.1.2		B. Open-Hearth Furnace
3.1.3		C. Bessemer Converter Furnace
3.1.4	Mainly used for the production of high-duty cast irons, especially those containing alloying elements like chromium molybdenum and nickel.	D. Electric Arc Furnace
3.1.5	Chiefly used for nails, screws, wire, rails and building materials such as beams.	E. Rotor Plant
3.1.6	First step in production of steel	
3.1.7	Used to produce stainless steel, other high-alloying steels, or special steels requiring very close metallurgical control of grain or other structural qualities.	
3.1.8	Used to convert scrap metal and other alloying elements into different kinds of steel.	

(8)

3.2 What are the three electrodes of an electric-arc furnace made of? (1)

3.3 Name the product produced by a blast furnace. (1)

3.4 Name the four main raw materials needed in the production of iron in a blast furnace. (4)

[14]

SECTION B – SPECIFIC

QUESTION 4 - MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.12) in your ANSWER BOOK, for example 1.13 A

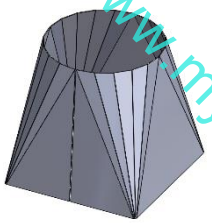
4.1 With a bench grinder, what is the maximum distance for the rest-plate to be positioned from the grinding wheel?

A. 6 mm
B. 5 mm
C. 4 mm
D. 3 mm (1)

4..2 There are three main reasons for malfunction in machines. Choose the option that does NOT fit.

A. Lack of lubrication or incorrect lubrication
B. Electrical burnout
C. Overloading
D. Friction (1)

4.3 What do you call the structure in the image below?



A. Square-on-square
B. Funnel
C. Development
D. Square-to-round transformer. (1)

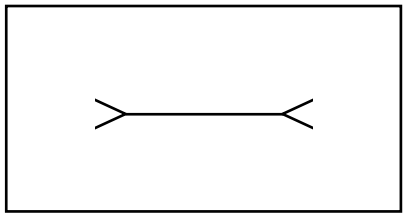
4.4 Carbon is the largest determining factor in the properties of plain carbon steel. If the carbon content is increased, certain changes will occur. Select the option that does NOT fit.

A. Greater hardness
B. Larger tensile strength
C. Becomes magnetic
D. Not as weldable (1)

4.5 Incomplete penetration during the welding process is caused when:
(Choose the correct option)

A. the weld bead does not reach the full depth of the weld or into the root of the weld.
B. dissolved gasses that are present in a molten weld metal.
C. improper welding parameters are present.
D. the entrapment of unwanted solid particles (slag, flux, foreign metal/oxide) are present. (1)

4.6 What is the nature of the member below?



A. Strut
B. Tie
C. Torsion force
D. Shear force (1)

4.7 Which of the following is NOT a step followed when carrying out the ring test on a bench grinder wheel?

A. Suspend the wheel from the centre hole.
B. Tap the wheel at 45° on either side of the vertical line.
C. Listen to the sound (dull or clear-ringing sound) to determine whether it is cracked or not.
D. Drop the wheel on the floor and listen to the sound (dull or clear-ringing sound) to determine whether it is cracked or not. (1)

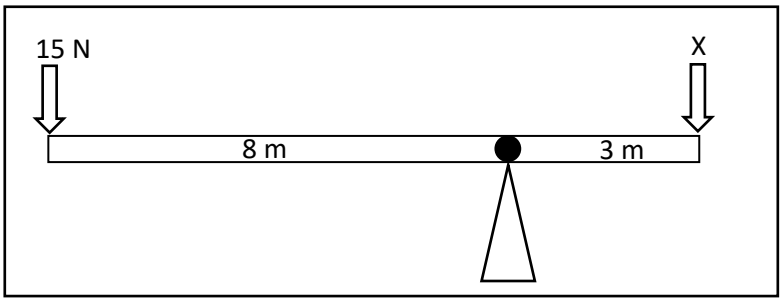
4.8 What is a lattice girder?

A. Retro girders welded together
B. Combination of plates and round bar welded together
C. Plane frames of open web construction, having triangulated bracing members between the upper and lower chords.
D. Hollow tubing welded together (1)

4.8 A tap can be used for cleaning internal threads on …

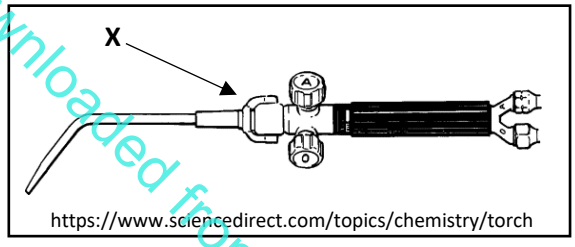
A. nuts
B. bolts
C. washers
D. keys (1)

4.9 What is the magnitude of force X shown in the figure below?



A. 40 N
B. 47.5 N
C. 45 N
D. 427.5 N (1)

4.10 Component X in the figure below shows which part of the blowtorch?

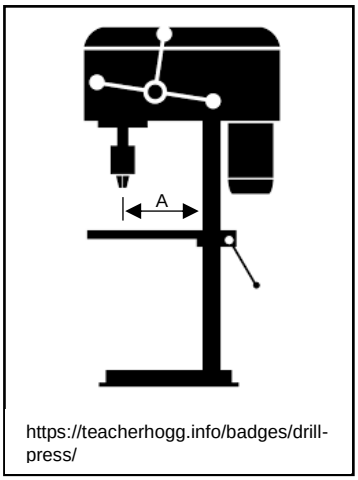


A. Nozzle
B. Mixing Chamber
C. Electrode holder
D. Acetylene valve (1)

4.11 What is the maximum cutting thickness of a manual guillotine?

A. 0,5 mm
B. 1,2 mm
C. 2,5 mm
D. 3 mm (1)

4.12 Refering to the simplified image of a drill press in the figure below, what does A refer to?



https://teacherhogg.info/badges/drill-press/

A. Maximum chuck to base distance
B. Drilling pitch
C. Maximum drill bit size
D. Swing distance (1)

[12]

QUESTION 5 – WELDING TERMINOLOGY (TEMPLATES, TRUSSES, TERMS, WELDING SYMBOLS)

5.1 What does the abbreviation “TSU” on a template mean? (1)

5.2 Name TWO types of templates. (2)

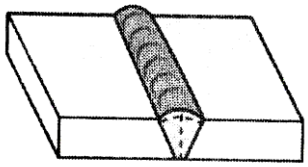
5.3 What are ‘backmarks / contramarks’? (2)

5.4 Make neat sketches of the weld symbol that represents the following welded joints in images below.
NB – redraw the image as a simplified sectional view of the workpiece(s) and draw in the complete and relevant weld symbol.
Also, name the type of weld(s).

Note how marks are allocated:

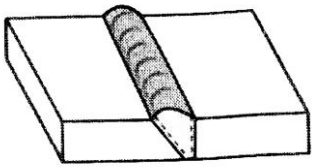
- Workpiece drawn as simplified sectional (2D) image **before welded, with edge preparation** x1 ✓
- Full weld symbol, drawn correct pointing towards workpiece (arrow, reference line, weld symbol, supplementary symbol, etc.) x1 ✓
- Weld symbol named correctly x1 ✓
- Weld joint named correctly x1 ✓

5.4.1



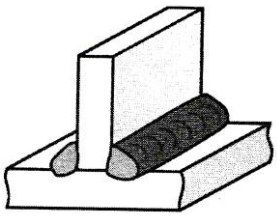
(4)

5.4.2



(4)

5.4.3



(4)

5.5 Name the FIVE basic weld joints. (5)

5.6 Name the FOUR basic weld positions. (4)

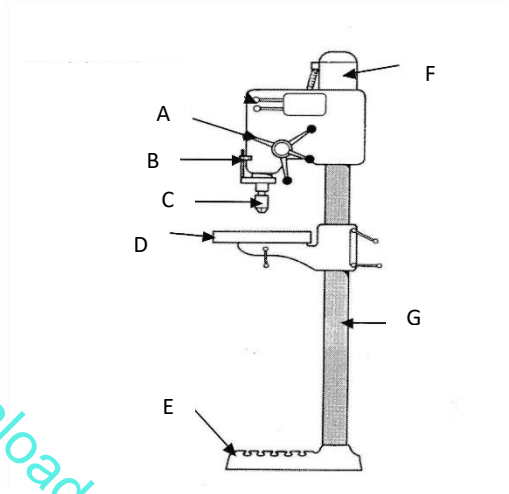
5.7 State ONE advantage of using templates. (1)

[27]

QUESTION 6 – TOOLS

6.1 To cut an internal thread by hand, a set of taps is employed. (4)
Name the three taps <u>in the order it is used.</u>

6.2 Name the different parts of a pedestal drill in the picture below. (7)



6.3 Name the THREE main types of rolling machines for metal plates. (3)

6.4 Name the THREE primary functions of angle grinders. (3)

6.5 State the primary purpose of a regulator in an oxy-acetylene welding system. (2)

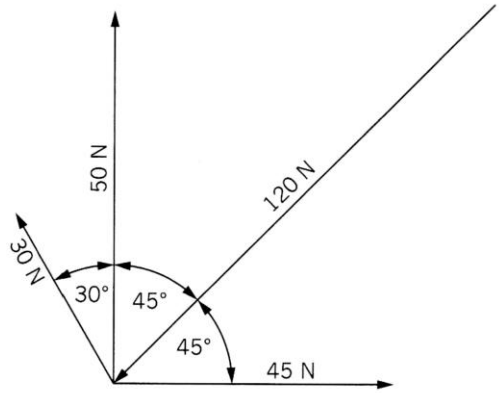
6.6 Name the tool below: (1)

[20]

QUESTION 7 - FORCES

7.1

7.1.1 Use the given space diagram to draw a force diagram on scale of 1 cm = 10 N.

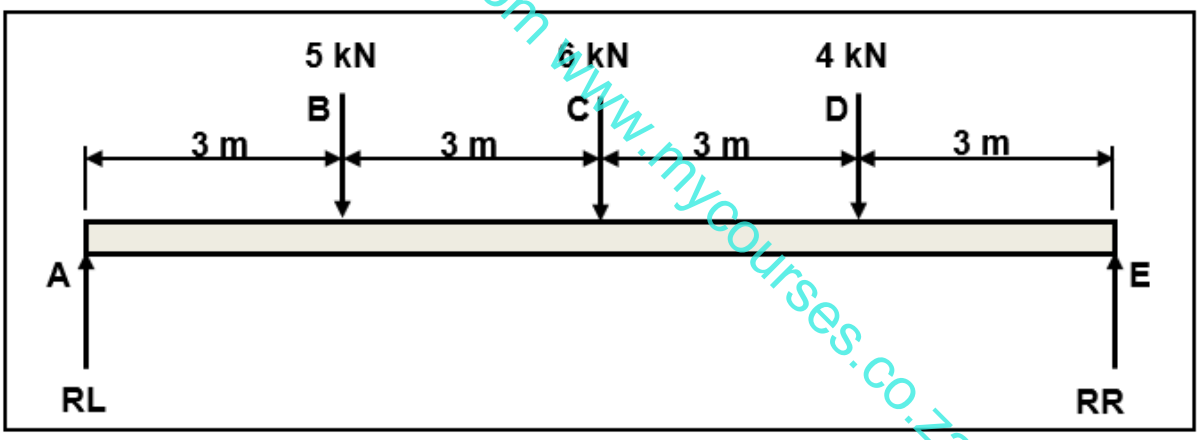


(5)

7.1.2 Determine the magnitude and direction of the equilibrant force. (2)

7.1.3 Determine the horizontal and vertical components of the equilibrant. (4)

7.2 The FIGURE below shows a simple supported beam subjected to three-point loads.



SCALE:

Space diagram:	10 mm = 1 m
Shear Force Diagram:	5 mm = 1 kN
Bending Moment Diagram	5 mm = 1 kN m

7.2.1 Calculate the reactions at the supports RL and RR. (6)

7.2.2 Calculate the shear forces at points A, B, C, D and E. (5)

7.2.3 Draw a shear force diagram of the beam. Use the given scale. (4)

7.3 A Ø 50 mm round bar lengthens by 0,2 mm in a tensile test under the load of 35 kN. Calculate Young's modulus for the bar if the original length was 60 mm. (9)

[35]

QUESTION 8 – MAINTENANCE

8.1 What is the purpose of service records? (2)

8.2 Explain how a guillotine can be overloaded. (1)

8.3 With reference to the blade-movement, explain the difference between a band saw and a power saw. (2)

8.4 Describe the sound(s) you will hear from a bench grinder's wheel when carrying out the ring test on a defective AND a defect-free wheel. (2)

8.5 Name the THREE main causes for malfunction of machines. (3)

8.6 What is the purpose of the additional holes in a lockout isolator? (1)

8.7 Name the following tools / equipment, and explain how they are used for machine maintenance:

8.7.1

(2)

8.7.2

(2)

[15]

QUESTION 9 - JOINING METHODS

9.1 What does keyhole welding provide in a weld joint? (1)

9.2 Name the THREE basic 'welding sequences' that is applied to prevent distortion. (1)

9.3 What does the abbreviation 'SMAW' stand for? (1)

9.4 Explain the process of spot-welding/resistance welding. (3)

9.5 Define the following welding defects:

9.5.1 Porosity (2)

9.5.2 Blow holes (2)

9.5.3 Undercutting (2)

9.5.4 Slag Inclusion (2)

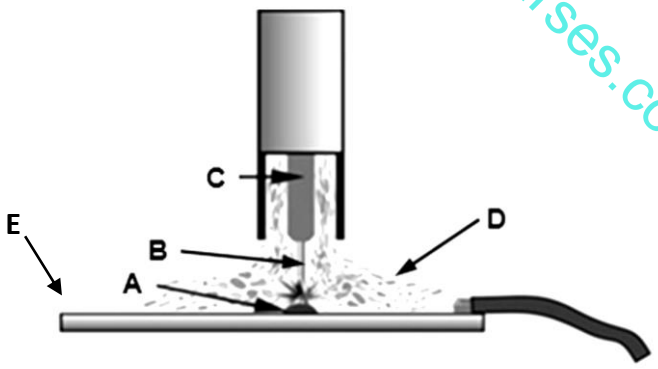
9.6 Give ONE reason for conducting EACH of the following heat-treatment processes on steel:

9.6.1 Hardening (1)

9.6.2 Case hardening (1)

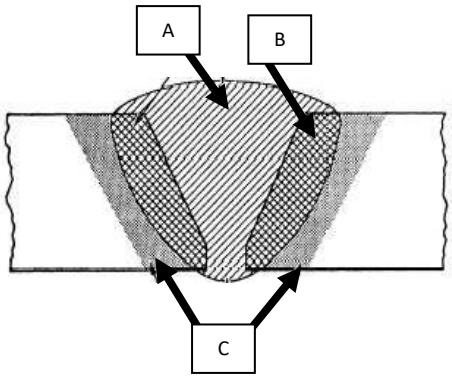
9.6.3 Normalising (1)

9.7 Label the parts of the sketch below of a MIG welding nozzle.



(5)

9.8 Label the different zones of the following weld:



(3)

[25]

QUESTION 10 – TERMINOLOGY (SECTIONS)

10.1 Attached to the back of the question paper, find the ANNEXURE for this question.

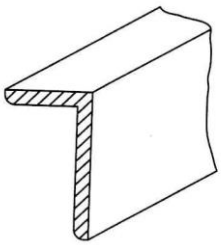
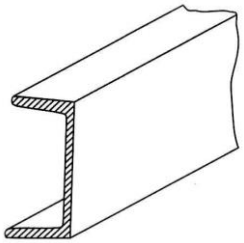
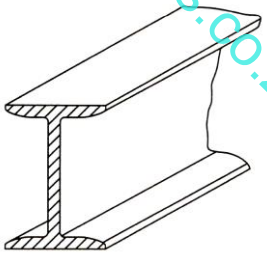
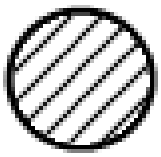
Draw the development of the Square-to-square (off centre) transition piece, according to **cutting plane X-X**. Use the points on the transition piece as they are provided on the sketch.
The surface showing points A, B, 1, 2, 3, and 4 must be drawn / constructed.
Use the scale of the images as printed on the page. (16)

[16]

QUESTION 11 – TERMINOLOGY (METAL SECTIONS)

11.1

Name the following steel sections/profiles:

11.1.1	11.1.2	11.1.3	11.1.4
 (1)	 (1)	 (1)	 (1)

11.2 Draw, in neat freehand, the following steel sections:

11.2.1 Square bar (1)

11.2.2 Angle iron (equal leg length) (1)

11.2.3 T-beam (1)

11.3 Describe the purpose of an assembly jig in a welding workshop. (2)

11.4 State THREE advantages of using a well-designed jig in a welding workshop. (3)

11.5 Illustrate, with freehand drawings, TWO preparation methods of the ends of two equal angle-iron bars that have to be welded at 90° to each other. (4)

11.6 Define notching. (2)

[18]

TOTAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY

(WELDING AND METALWORK)

1. STRESS AND STRAIN

$$\text{Stress} = \frac{\text{Force}}{\text{Area}} \quad \text{or} \quad \sigma = \frac{F}{A}$$

$$\text{Strain} = \frac{\text{change in length}}{\text{original length}} \quad \text{or} \quad \varepsilon = \frac{\Delta L}{L}$$

$$\text{Young's modulus} = \frac{\text{stress}}{\text{strain}} \quad \text{or} \quad E = \frac{\sigma}{\varepsilon}$$

$$\text{Safety factor} = \frac{\text{Maximum stress / Breakstress}}{\text{Safe working stress}}$$

$$A_{shaft} = \frac{\pi d^2}{4}$$

$$A_{pipe} = \frac{\pi(D^2 - d^2)}{4}$$

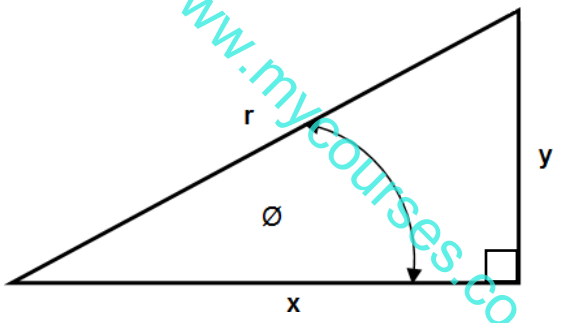
2. PYTHAGORAS' THEOREM AND TRIGONOMETRIC RATIOS

$$\sin\theta = \frac{y}{r}$$

$$\cos\theta = \frac{x}{r}$$

$$\tan\theta = \frac{y}{x}$$

$$r^2 = x^2 + y^2$$



3. TEMPLATES AND DEVELOPMENTS

Mean Ø = outside-Ø – plate thickness

Mean Ø = inside-Ø + plate thickness

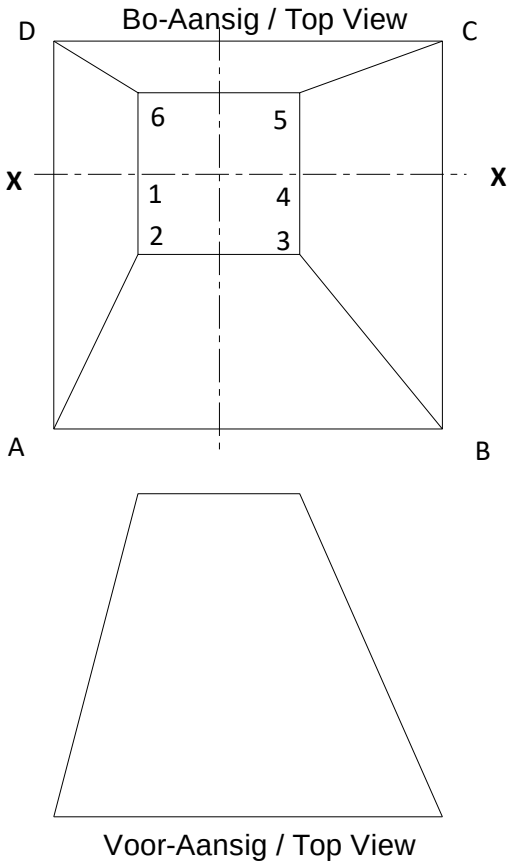
Mean circumference = π x mean Ø

(where Ø = diameter)

ANNEXURE - 10.1 DEVELOPMENT

Name & Surname: _____

NB – Remove this page from the Question Paper and attach this page to the Answer Script



RUBRIC		
Description:	**Mark:**	**Max.**
True lengths		7
Construction		5.5
Construction lines dashed		1.5
Neatness		2
TOTAL:		**16**