



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2019**

**MECHANICAL TECHNOLOGY:  
WELDING AND METALWORK**

**MARKS: 200**

**TIME: 3 hours**



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This question paper consists of 20 pages, including a 2-page formula sheet.

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**INSTRUCTIONS AND INFORMATION**

1. Write your NAME 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. You may use a non-programmable scientific calculator and drawing instruments.
8. The value of gravitational force should be taken as  $10 \text{ m.s}^{-2}$
9. All dimensions are in millimetres, unless stated otherwise in the question.
10. A formula sheet is attached to the question paper.
11. Write neatly and legibly.
12. Use the criteria below to assist you in your time management.

QUESTION	CONTENT	MARKS	TIME in minutes
<b>GENERIC</b>			
1	Multiple-choice questions	20	18
2	Safety	24	22
3	Tools and Equipment	16	14
4	Maintenance	8	7
5	Materials	32	29
<b>SPECIFIC</b>			
6	Welding Terminology	18	15
7	Tools and Equipment	7	5
8	Forces	17	15
9	Maintenance	6	5
10	Joining Methods	15	15
11	Terminology (Development)	19	25
12	Terminology (Steel Sections)	18	20
<b>TOTAL:</b>		<b>200</b>	<b>180</b>

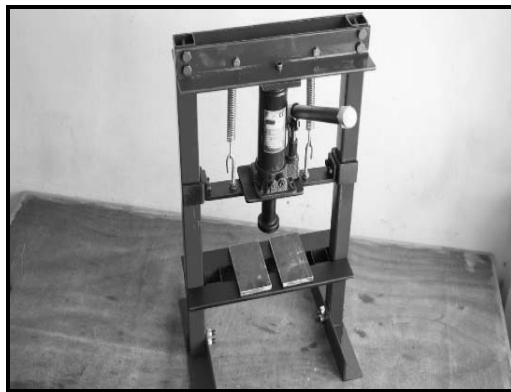
**QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)**

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 numbers (1.1–1.20) in your ANSWER BOOK, for example 1.21 A.

1.1 Which safety measure is applicable to guillotines in terms of the OHS Act?

- A Clamp the work piece securely to the table
  - B Do not leave the chuck key on the machine
  - C Machine must be fitted with fixed guards to prevent fingers from reaching through the point of operation
  - D Use the table of the machine as an anvil
- (1)

1.2 Which ONE of the following safety procedures is applicable to the press machine?



**FIGURE 1.2**

- A Hold the material firmly to prevent inaccurate cutting of material
  - B Make sure not to exceed pressure limit of the machine
  - C Use this machine only to cut sheet metal, not rods or angle iron
  - D Use this machine only to bend rods or angle iron
- (1)

1.3 Which ONE of the following welding or flame cutting operations may not be undertaken unless ...

- A an operator has been instructed on how to use the equipment safely.
  - B a work place is partitioned off.
  - C an operator uses protective equipment.
  - D All of the above.
- (1)

1.4 Which ONE of the following safety procedures is applicable to the operation of a hydraulic press?

- A Do not apply wrench to revolving work
  - B Guards could be removed when pressing soft material
  - C Pressure gauges must be tested regularly and adjusted or replaced if any malfunction occurs
  - D Use the machine table as an anvil
- (1)

- 1.5 What safety measure is applicable to the use of the bench grinder in terms of the Occupational Health and Safety Act?



**FIGURE 1.5**

- A The tool rest must not be more than 3 mm away from the grinding wheel surface  
B Remove guards before grinding  
C Grind on the sides of the grinding wheel  
D The grinding machine can be forced to grind thick material (1)
- 1.6 What is the purpose of cooling the blade of a band saw with cutting fluid?
- A To cause friction  
B To ensure clean cuts and remove metal waste  
C To sharpen the blade during the cutting process  
D To ensure straight cut (1)
- 1.7 What is the function of the extension bars of a guillotine?
- A To enlarge the size of material  
B To support the guards  
C To support longer pieces of material  
D To activate the foot pedal of the machine (1)
- 1.8 Which ONE of the following is an incorrect function of an angle grinder?



**FIGURE 1.8**

- A Drilling  
B Grinding  
C Cutting  
D Polishing (1)

- 1.9 Which ONE of the following is a component of a pedestal drilling machine?
- A Pressure gauge
  - B Grinding wheel
  - C Chuck
  - D Tool rest
- (1)
- 1.10 Which ONE of the following tools is used for marking off?
- A Allen key
  - B Scriber
  - C Circlip plier
  - D Steel ruler
- (1)
- 1.11 What is the purpose of lubricating moving parts of machines?
- A To prevent moisture
  - B To prevent rust
  - C To minimise overloading
  - D To prevent incorrect lubrication
- (1)
- 1.12 Maintenance of a power saw includes, amongst others, to check ...
- A guide alignment.
  - B belt tension.
  - C transmission oil level.
  - D All of the above.
- (1)
- 1.13 Overloading in pedestal grinders can result in machine malfunction due to ...



**FIGURE 1.13**

- A excessive load on the spindle bearing.
  - B friction.
  - C power loss.
  - D bearings.
- (1)

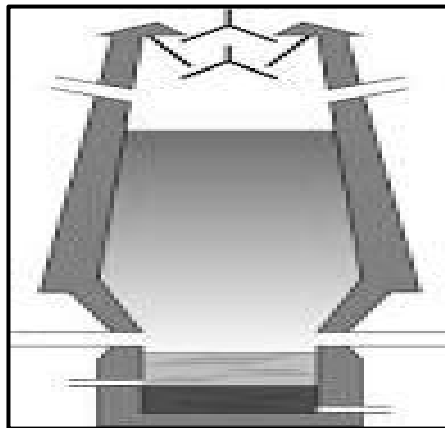
1.14 Which ONE of the following methods is used to reduce friction between two moving parts?

- A Use sufficient lubrication
  - B To increase the temperature between two metals
  - C To add abrasives to the contact area
  - D To increase the speed
- (1)

1.15 Lack of maintenance on a bench grinder will cause the following to happen:

- A Inaccurate grinding results
  - B Sharp edges on the work piece
  - C Insufficient lubrication of the grinding wheel
  - D High speed grinding
- (1)

1.16 What gets smelted in a blast furnace?



**FIGURE 1.16**

- A Rocks
  - B Iron ore
  - C Pig iron
  - D Carbon
- (1)

1.17 The unit for torque is ...

- A mm.
  - B Pa.
  - C N.
  - D Nm.
- (1)

1.18 Which of the following properties of material allows a material to return to its original shape when the load is removed?

- A Hardness
  - B Brittleness
  - C Elasticity
  - D Malleability
- (1)

1.19 The most common method of extracting iron from iron ore is called ...

- A tempering.
- B smelting.
- C elasticity.
- D charging.

(1)

1.20 Which element is used to make coke in a blast furnace?

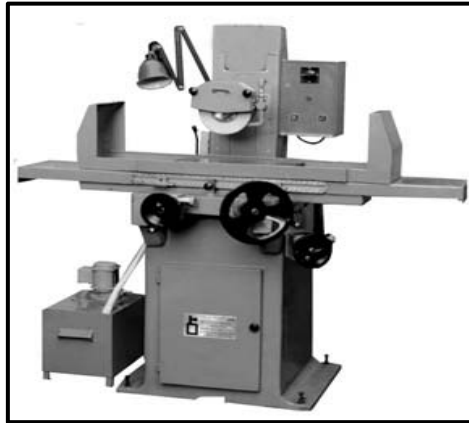
- A Limestone
- B Coal
- C Dolomite
- D Iron ore

(1)

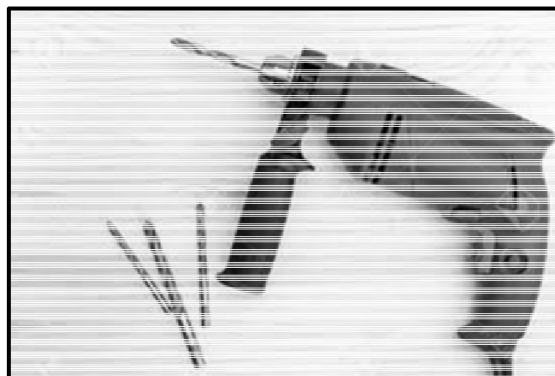
**[20]**

**QUESTION 2: SAFETY (GENERIC)**

- 2.1 Name any THREE pieces of personal safety equipment that you need to wear when using gas welding equipment. (3)
- 2.2 State THREE safety precautions you should observe before pressing a bearing from a shaft on a hydraulic press. (3)
- 2.3 Give THREE safety rules that must be followed while the surface grinder is in operation.

**FIGURE 2.3**

- (3)
- 2.4 When completing a task on any machine, what safety aspect must be considered before leaving the machine? (1)
- 2.5 State THREE safety measures to observe before switching on the bench grinder. (3)
- 2.6 What is the function of the Perspex shield of a pedestal grinder? (1)
- 2.7 State THREE safety rules to apply when using a portable hand drill machine.

**FIGURE 2.7**

- (3)
- 2.8 Give THREE safety rules to follow when handling gas cylinders. (3)
- 2.9 State THREE safety rules one must adhere to before switching on a band saw. (3)
- 2.10 Which safety precaution should be adhered to when drilling a hole on a small work piece on a drill press? (1)

**[24]**



**QUESTION 3: TOOLS (GENERIC)**

3.1 What is the function of the diagram shown in FIGURE 3.1 below?



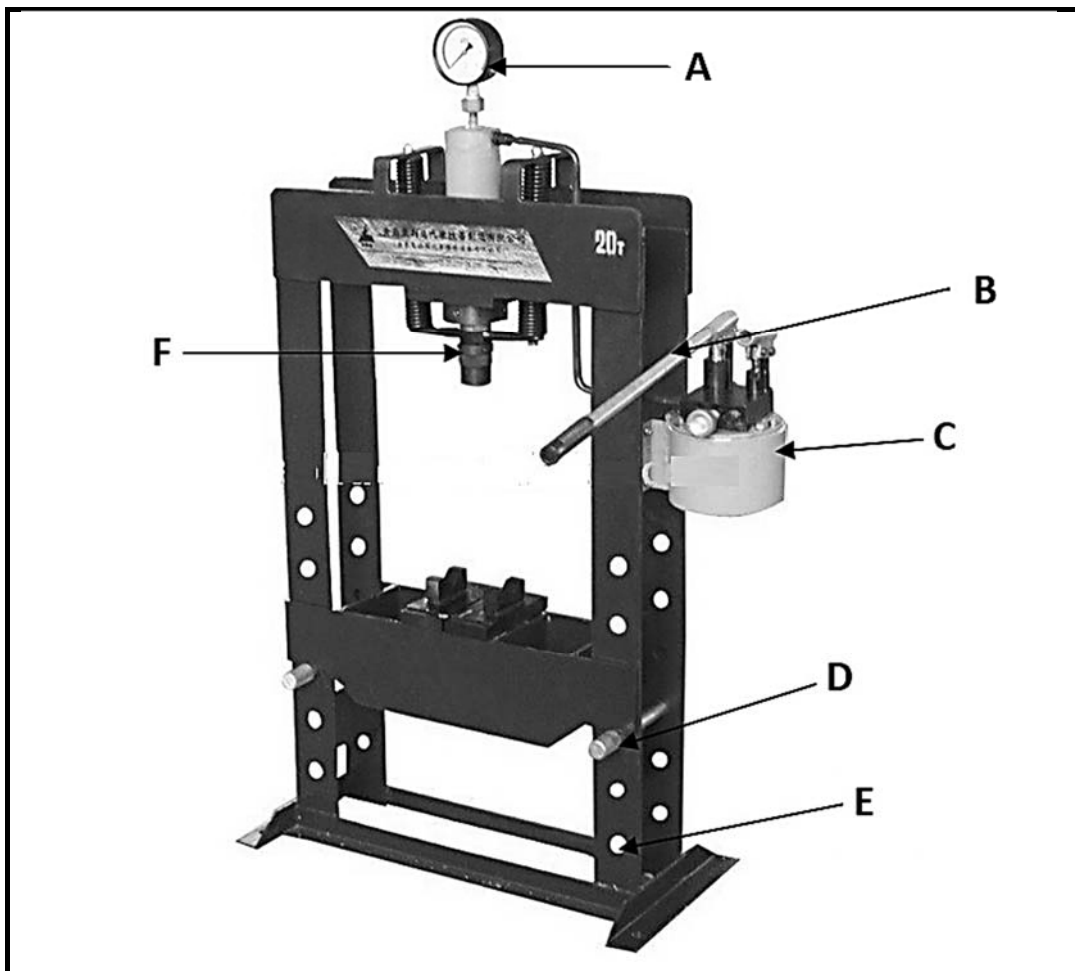
**FIGURE 3.1**

(2)

3.2 Explain the purpose of the extension bars of a guillotine.

(2)

3.3 FIGURE 3.3 below shows a hand-operated hydraulic press. Label parts A–F.



**FIGURE 3.3: HAND-OPERATED HYDRAULIC PRESS**

(6)

3.4 Describe the function of the following equipment:

3.4.1 Angle grinder

(2)

3.4.2 Rolling machine

(2)

3.4.3 Press machine

(2)

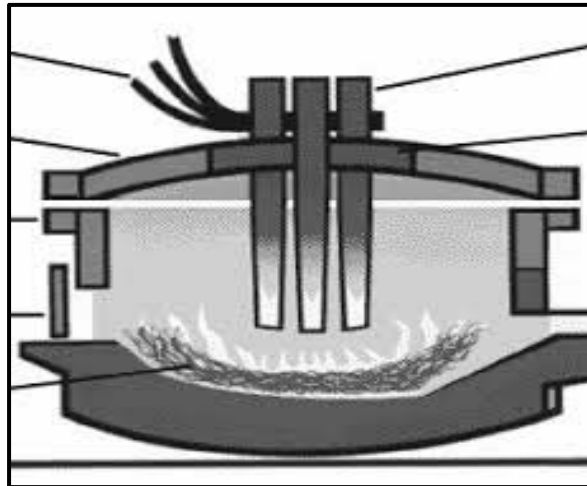
**[16]**

**QUESTION 4: MAINTENANCE (GENERIC)**

- 4.1 Explain the maintenance of a pedestal grinder with regard to the guards. (2)
- 4.2 How can friction be reduced when drilling holes? (2)
- 4.3 What do you understand by *overloading*? (2)
- 4.4 State the results of the lack of lubrication in a gear system. (2)

**[8]****QUESTION 5: MATERIALS (GENERIC)**

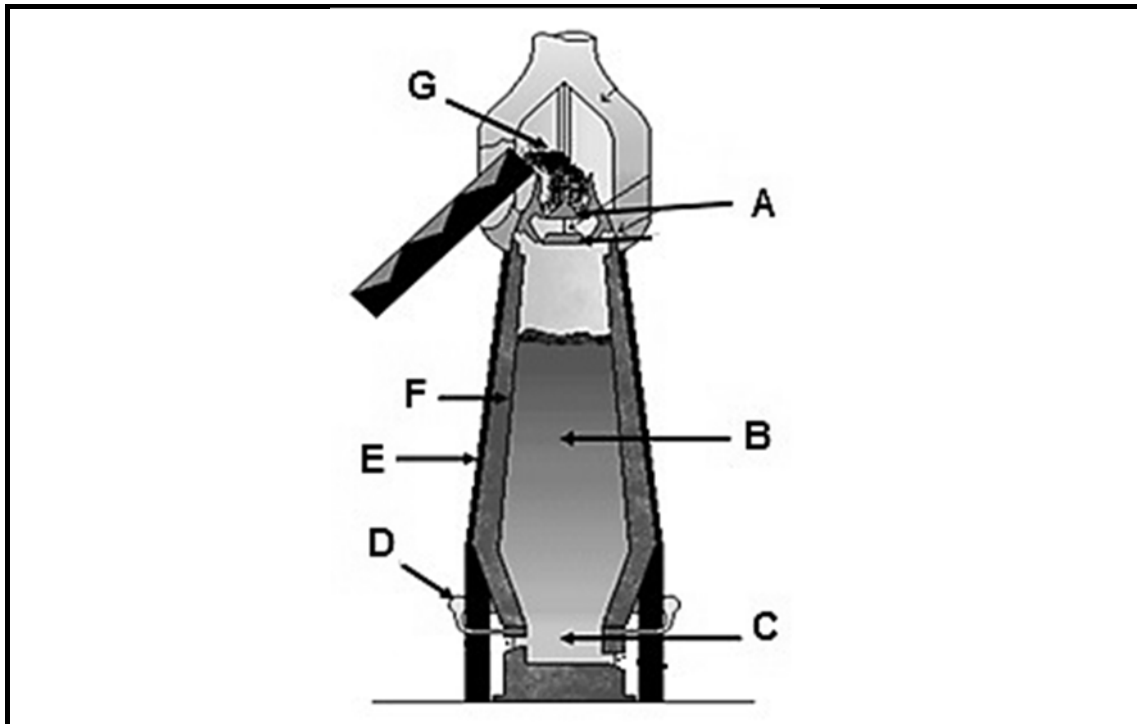
- 5.1 Name THREE raw materials needed in the production of iron. (3)
- 5.2 What is the name of the product produced by the blast furnace? (1)
- 5.3 Describe the operation of an electric arc furnace. (3)

**FIGURE 5.3**

(3)

- 5.4 State the function of each of the following furnaces:
- 5.4.1 Blast furnace (2)
- 5.4.2 Bessemer converter furnace (2)
- 5.4.3 Open hearth furnace (2)

5.5 FIGURE 5.5 below shows the cross-sectional view of a furnace.

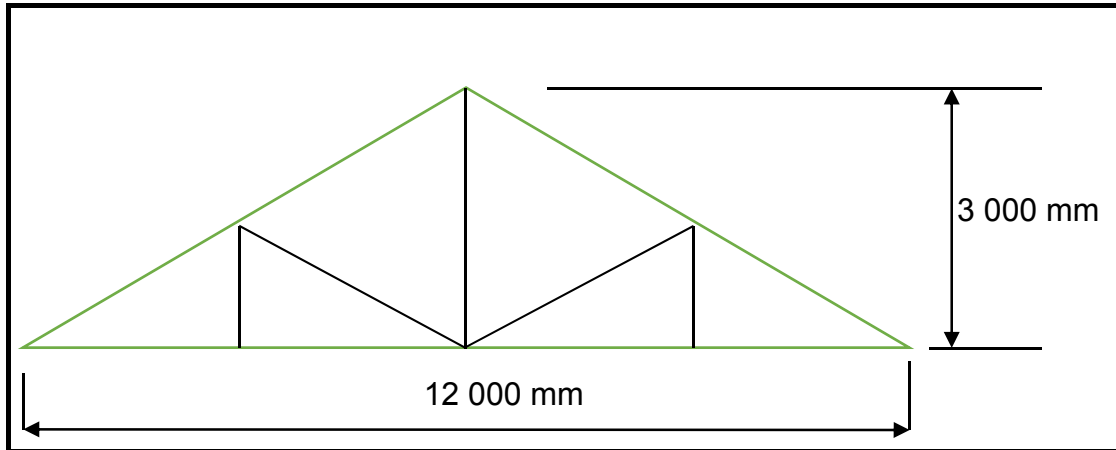


- 5.5.1 Identify the furnace in FIGURE 5.5 above. (1)
- 5.5.2 Label parts A–G. (7)
- 5.6 Melting in the rotor plant takes place in an atmosphere which, within limits, may be controlled. Name THREE advantages of this process. (3)
- 5.7 Describe the following terms which are used to identify the properties of metals:
  - 5.7.1 Ductility (2)
  - 5.7.2 Brittleness (2)
  - 5.7.3 Plasticity (2)
  - 5.7.4 Toughness (2)

[32]

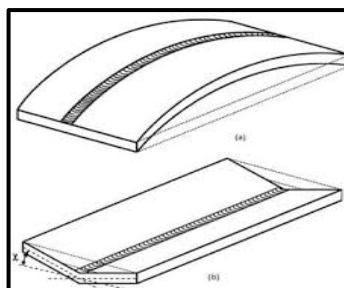
**QUESTION 6: WELDING TERMINOLOGY (SPECIFIC)**

- 6.1 What is a roof truss? (2)
- 6.2 FIGURE 6.2 below shows a roof truss with a span of 12 000 mm and a rise of 3 000 mm.

**FIGURE 6.2**

Calculate the following:

- 6.2.1 The pitch (2)
- 6.2.2 The slope (2)
- 6.2.3 The rafter length (2)
- 6.3 Name TWO advantages of using a template. (2)
- 6.4 Explain the following welding terms:
- 6.4.1 Fusion zone (2)
- 6.4.2 Weld metal (2)
- 6.5 Identify the following supplementary symbols:
- 6.5.1 **M** (1)
- 6.5.2 **G** (1)
- 6.6 Which TWO methods can be used to reduce distortion when welding? (2)



(2)  
**[18]**

**QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)**

7.1 What is the purpose of the oxy-acetylene regulators? (1)



7.2 Which rolling machine is used for bending thick heavy plates? (1)

7.3 What is the use of the guillotine? (1)



7.4 Describe the function of the punching machine. (2)

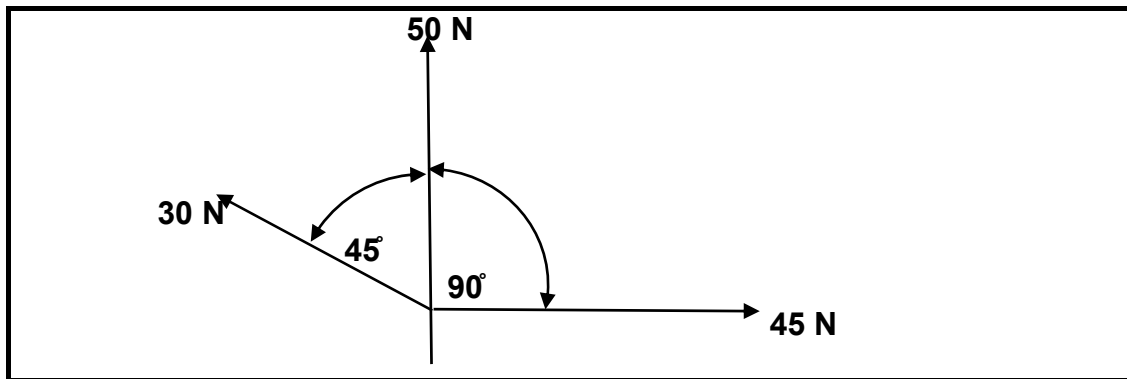
7.5 Name TWO advantages of a plasma cutter as compared to an oxy-acetylene cutting torch.



(2)  
[7]

**QUESTION 8: FORCES (SPECIFIC)**

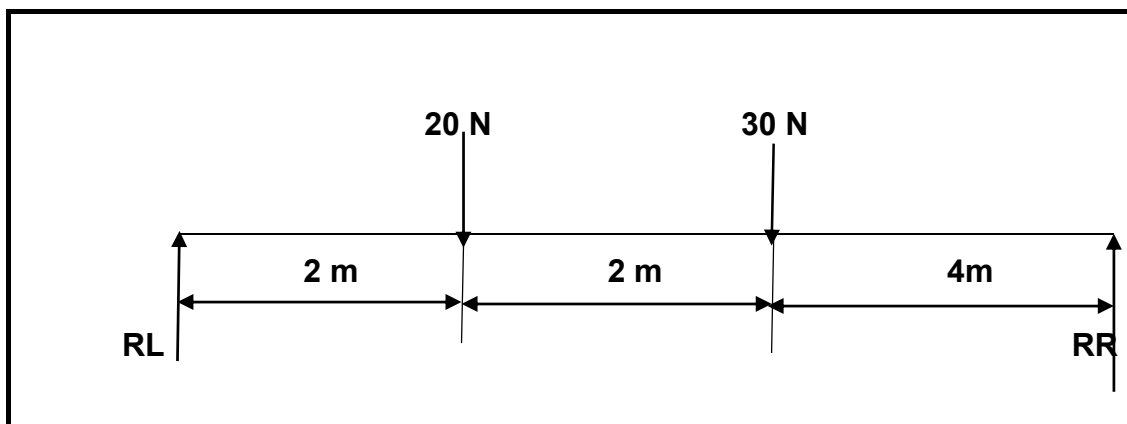
8.1 FIGURE 8.1 below shows a system of forces.



**FIGURE 8.1**

Calculate the following:

- 8.1.1 The resultant of the horizontal components (3)
- 8.1.2 The resultant of the vertical components (3)
- 8.2 FIGURE 8.2 below shows a beam that is supported by two vertical supports **RL** and **RR**. Two vertical point loads, 20 N and 30 N, are exerted onto the beam over the total distance of 8 metres. Determine, by means of calculations, the magnitude of the reactions in supports **RL** and **RR**.



**FIGURE 8.2**

- 8.3 A round tube with an inside diameter of 21 mm and an outside diameter of 25 mm is subjected to a tensile load of 10 kN. Calculate the tensile stress in the bar in Mega units.

(5)  
[17]

**QUESTION 9: MAINTENANCE (SPECIFIC)**

- 9.1 What are the effects of overloading the rolling machine? (2)
- 9.2 State ONE precaution to take to prevent excessive wear on a guillotine. (1)
- 9.3 Explain the effects of lack of lubrication of the punch and shear machine. (2)



- 9.4 State an example of a machine where friction is not a relevant factor. (1)
- [6]**

**QUESTION 10: JOINING METHODS (SPECIFIC)**

- 10.1 Draw a neat sketch of the iron carbon equilibrium diagram and indicate the following:
- 10.1.1 Carbon content from 0% to 1,4% (1)
  - 10.1.2 Temperature range from 0 to 1 000 °C (1)
  - 10.1.3 AC 1 line (1)
  - 10.1.4 AC 3 line (1)
  - 10.1.5 Austenite (1)
- 10.2 Describe the purpose of the normalising process. (2)
- 10.3 What does the abbreviation MIGS stand for with regard to welding? (1)
- 10.4 Name ONE cause and ONE possible remedy for undercutting as a weld defect in arc welding. (2)
- 10.5 Explain the following welding joints by means of sketches:
- 10.5.1 Lap joint (2)
  - 10.5.2 Fillet joint (2)
- 10.6 Name ONE type of inert gas used for MIG/MAGS welding.

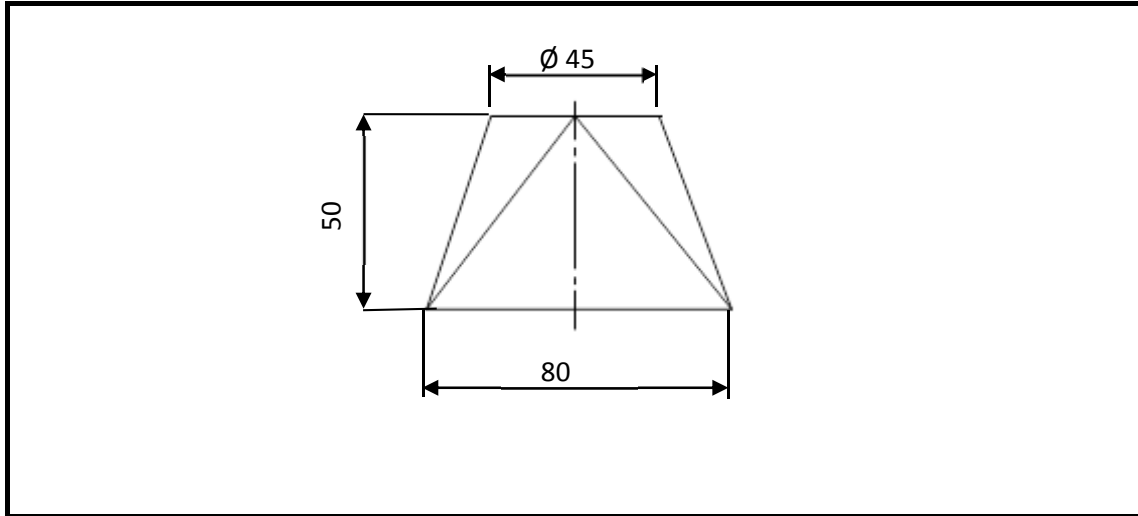


(1)  
**[15]**



**QUESTION 11: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)**

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



**FIGURE 11.1**

(19)  
[19]

**QUESTION 12: TERMINOLOGY (STEEL SECTIONS) (SPECIFIC)**

- 12.1 Explain by means of simple sketches the following types of steel bars:
- 12.1.1 Square bar (2)
  - 12.1.2 Flat bar (2)
- 12.2 Describe the purpose of an assembly jig in a welding workshop. (2)
- 12.3 Illustrate a channel iron by means of a neat sketch. (4)
- 12.4 Illustrate, with a freehand isometric drawing, TWO preparation methods of the ends of two equal angle-iron bars that have to be welded at 90° to each other. (4)
- 12.5 Describe an I-Beam. (2)
- 12.6 State the disadvantage of welding steel sections. (2)
- [18]**

**TOTAL: 200**

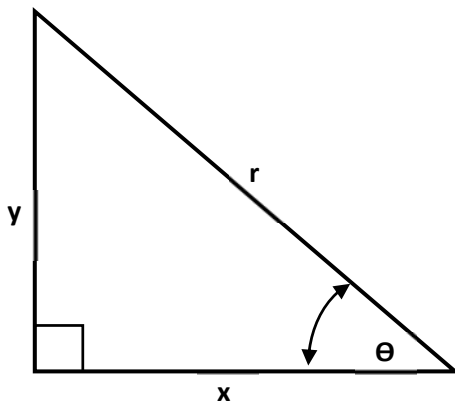
**FORMULA SHEET FOR MECHANICAL TECHNOLOGY  
(WELDING AND METALWORK)**

**1. STRESS AND STRAIN**

$$1.1 \quad \text{Stress} = \frac{\text{Force}}{\text{Area}} \quad \text{or} \quad \sigma = \frac{F}{A}$$

$$1.2 \quad \text{Young's modulus} = \frac{\text{Stress}}{\text{Strain}} \quad \text{or} \quad E = \frac{\sigma}{\varepsilon}$$

$$1.3 \quad \text{Strain} = \frac{\text{Change in length}}{\text{Original length}} \quad \text{or} \quad \varepsilon = \frac{\Delta l}{l}$$

**2. PYTHAGORAS' THEOREM AND TRIGONOMETRY**

$$2.1 \quad \sin \theta = \frac{y}{r}$$

$$2.2 \quad \cos \theta = \frac{x}{r}$$

$$2.3 \quad \tan \theta = \frac{y}{x}$$

$$2.4 \quad r^2 = x^2 + y^2 \quad \text{or} \quad a^2 = b^2 + c^2$$



### 3. TEMPLATES AND DEVELOPMENTS

3.1 Mean  $\phi$  = Outside  $\phi$  – Plate thickness or  
Mean  $\phi$  = Inside  $\phi$  + Plate thickness

3.2 Mean circumference =  $\pi \times$  Mean  $\phi$

### 4. KEYS

4.1 Width of key =  $\frac{\text{Diameter of shaft}}{4}$

4.2 Thickness of key =  $\frac{\text{Diameter of shaft}}{6}$

4.3 Length of key = 1,5 x Diameter of shaft

4.4 Standard taper for taper key: 1 in 100 or 1 : 100

