



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2018

**MECHANICAL TECHNOLOGY
WELDING AND METAL WORK**

MARKS: 200

TIME: 3 hours

This question paper consists of 16 pages, including a 1-page formula sheet.

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 m.s^{-2} .
9. All dimensions are in millimeters, 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
GENERIC			
1	Multiple-choice questions	20	15 minutes
2	Safety	24	15 minutes
3	Tools and Equipment	16	10 minutes
4	Maintenance	8	10 minutes
5	Materials	32	25 minutes
SPECIFIC			
6	Welding Terminology (templates, trusses, cost calculations, terms, welding symbols) (Specific)	18	18 minutes
7	Tools and Equipment (Specific)	7	5 minutes
8	Forces (Specific)	17	15 minutes
9	Maintenance (Specific)	6	5 minutes
10	Joining Methods (Specific)	15	15 minutes
11	Terminology (development) (Specific)	19	27 minutes
12	Terminology (steel sections) (Specific)	18	20 minutes
TOTAL:		200	180 minutes

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

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

- 1.1 The legal responsibilities of an employer with regards to health and safety include:
- A Making employees pay for replacing damaged or lost PPE
 - B Providing safe working conditions for all employees
 - C Taking out additional insurance for dangerous work
 - D Ensuring that only one member of staff works on a dangerous job (1)
- 1.2 Which ONE of the following safety procedures applies to the maintenance of a hydraulic press?
- A Do not apply a wrench to a revolving part.
 - 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)
- 1.3 Which of the following is a safety device used in conjunction with guillotines?
- A Fixed guard
 - B Self-adjusting guard
 - C Auto push-away guard
 - D All of the above (1)
- 1.4 Which of the responsibilities of the OHS Act 85 of 1993, are NOT applicable to a person in charge of machines?
- A Installing and properly maintaining machinery
 - B Repairing machinery
 - C Ensuring that safety appliances and guards are in a good condition
 - D Running in the workshop (1)
- 1.5 Welding or flame cutting operations may be undertaken, unless ...
- A an operator has been refused permission to check the equipment.
 - B an operator has been instructed on how to use the equipment safely
 - C a workplace is under surveillance.
 - D an operator is intoxicated. (1)

1.6 The definition for *case hardening*:

- A To produce a wear resistant surface over a tough core
 - B To produce an extremely hard surface over a soft core
 - C To produce a high carbide surface over a hard core
 - D Not one of the above-mentioned
- (1)

1.7 Inside the blast furnace, impurities from the ore become trapped in which element?

- A Cupola
 - B Stove
 - C Molten limestone
 - D Carbon monoxide
- (1)

1.8 Linear motion is the motion along a ...



FIGURE 1.8

- A flywheel.
 - B y-axis.
 - C straight line.
 - D grinding wheel.
- (1)

1.9 The set of taps comprises of the following:

- A The taper tap
 - B The intermediate tap
 - C The plug/bottoming tap
 - D All of the above
- (1)

1.10 Which of the following is NOT a property of metals?

- A Metallurgy
 - B Machinability
 - C Malleability
 - D Ductility
- (1)

- 1.11 The hydraulic press is a device that uses a hydraulic cylinder to generate a ... force.
- A tensile
 - B shear
 - C compressive
 - D advance
- (1)
- 1.12 Which ONE of the following fluids can be used to reduce friction in mechanical engineering?
- A Water
 - B Grease
 - C Thinners
 - D Anti-freeze fluid
- (1)
- 1.13 What is understood by the term *viscosity* regarding liquids? It is the resistance to ...
- A flow.
 - B boil.
 - C cool.
 - D foam.
- (1)
- 1.14 Which of the following colours are used with oxygen cylinders?
- A Red
 - B Orange
 - C Green
 - D Black
- (1)
- 1.15 What are the electrodes of an electric-arc furnace made off?
- A Copper
 - B Stainless steel
 - C Carbon
 - D Cast Iron
- (1)
- 1.16 The aim for maintenance of mechanical equipment is ...
- A to stop machinery regularly.
 - B to increase the lifespan of the equipment.
 - C to operate at a higher speed.
 - D to operate at average speed.
- (1)
- 1.17 The most important method of extracting iron from iron ore is ...
- A smelting.
 - B charging.
 - C alloying.
 - D tempering.
- (1)

- 1.18 To determine the drilling speed on a drill press, you need to take into account various factors. Which of the following must be considered?
- A Type of material
 - B Diameter of drill bit
 - C Material that the drill bit is made of
 - D All of the above
- (1)
- 1.19 A 15 mm diameter hole need to be drilled into a piece of sheet metal, with a cutting speed of 600 mm per second. What will the drill speed be in revolutions per minute?
- A 380 revs/minute
 - B 674 revs/minute
 - C 764 revs/minute
 - D 830 revs/minute
- (1)
- 1.20 What does lockout refer to in machine maintenance?
- A To open the machines
 - B To enlarge the locks on the machines
 - C To isolate the machine completely
 - D To switch off the machine
- (1)
- [20]**

QUESTION 2: SAFETY (GENERIC)

- 2.1 State THREE safety measures to observe when using the arc welding equipment, FIGURE 2.1.

**FIGURE 2.1**

(3)

- 2.2 Give THREE basic rules that apply to machine guards in the workshop. (3)
- 2.3 State THREE safety precautions to apply when using a bending press (Box and Pan folder), FIGURE 2.3.

**FIGURE 2.3**

(3)

- 2.4 What does the regulation under the OHS Act (clause C3) refers to in terms of reporting to persons in charge of a workshop? (1)
- 2.5 Name THREE general safety rules one must adhere to before switching on the portable grinder, FIGURE 2.5.

**FIGURE 2.5**

(3)

- 2.6 What safety precautions should be adhered to when drilling a flat steel plate on a drill press? (1)
- 2.7 State THREE safety rules to be observed when using a surface grinder. (3)
- 2.8 Identify any THREE types of personal protective equipment (PPE) needed when using gas welding equipment. (3)
- 2.9 Give TWO examples of unsafe conditions in the workshop. (2)
- 2.10 Name the TWO main categories that the Occupational Health and Safety regulation can be divided into. (2)

[24]

QUESTION 3: TOOLS (GENERIC)

3.1 FIGURE 3.1 below shows a type of cutting machine that removes material in which abrasive particles are rotated at high speed against the material being grounded. Answer the questions that follow.

3.1.1 Identify the machine in FIGURE 3.1 below.

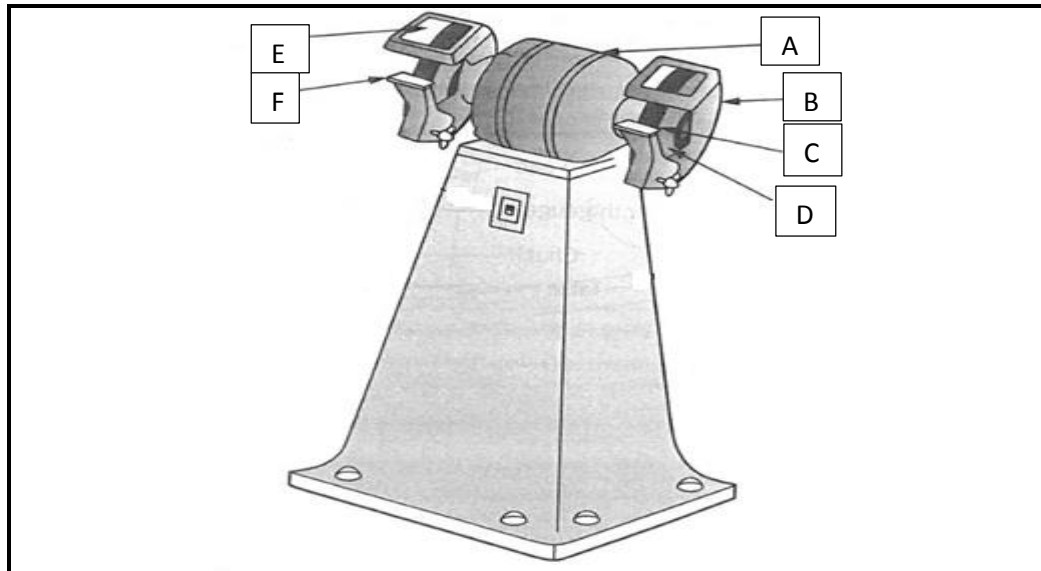


FIGURE 3.1

(1)

3.1.2 Label the parts marked **A–F**.

(6)

3.1.3 What is the purpose of part **E**?

(1)

3.2 What is the function of the manual guillotine?

(2)

3.3 Name the TWO main categories that presses fall into.

(2)

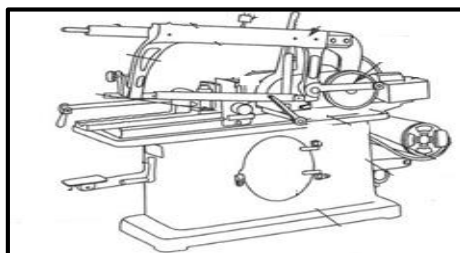
3.4 What is the function of the following equipment?

3.4.1 Horizontal band saw



(2)

3.4.2 Power saw



(2)

[16]

QUESTION 4: MAINTENANCE (GENERIC)

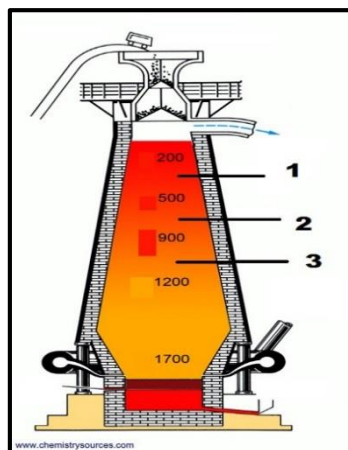
- 4.1 You are requested to drill a 25 mm hole into a mild steel plate, with a cutting speed of 700 mm per second.
Calculate the required cutting speed of the drill in revolutions per minute. (3)
- 4.2 State ONE result of a lack of lubrication on the chuck of a drilling machine. (1)



- 4.3 Define the term *overloading*, with regard to the drilling machine. (2)
- 4.4 What do you understand about the causes of malfunction of power saws (horizontal and band saws)? (2)
- [8]**

QUESTION 5: MATERIALS (GENERIC)

- 5.1 Distinguish between the following properties of engineering materials:
- 5.1.1 Plasticity (2)
 - 5.1.2 Ductility (2)
 - 5.1.3 Brittleness (2)
- 5.2 Which era is known as the Iron Age? (1)
- 5.3 Explain the operational principal of the blast furnace. (6)



5.4 FIGURE 5.4 below shows an electric arc furnace.

5.4.1 Label the parts marked **A – G**.

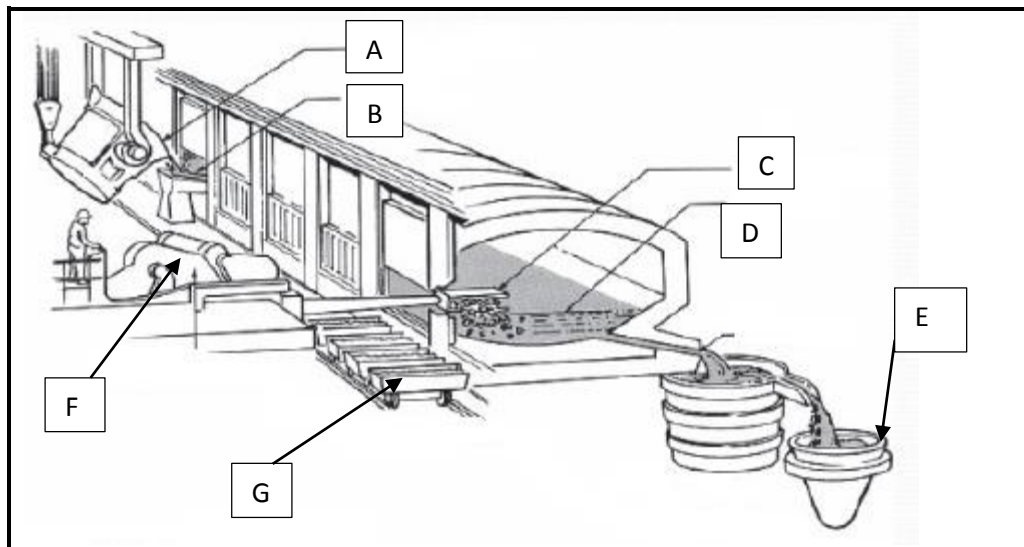
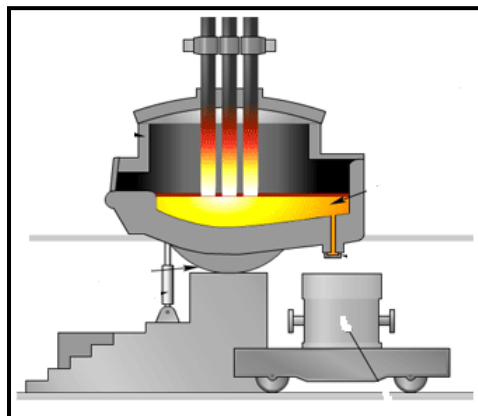


FIGURE 5.4

(7)

5.4.2 Describe the function of the electric arc furnace.



(2)

5.5 Briefly explain how cold chisels are tempered.

(4)

5.6 Which procedure will you follow to determine whether steel has been heated to a hardening temperature?

(2)

5.7 Explain the difference between *hardening* and *tempering*.

(4)

[32]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

- 7.1 Name THREE main types of arc welding machines. (3)
- 7.2 Describe how two plates are being put together by means of resistance welding. (2)



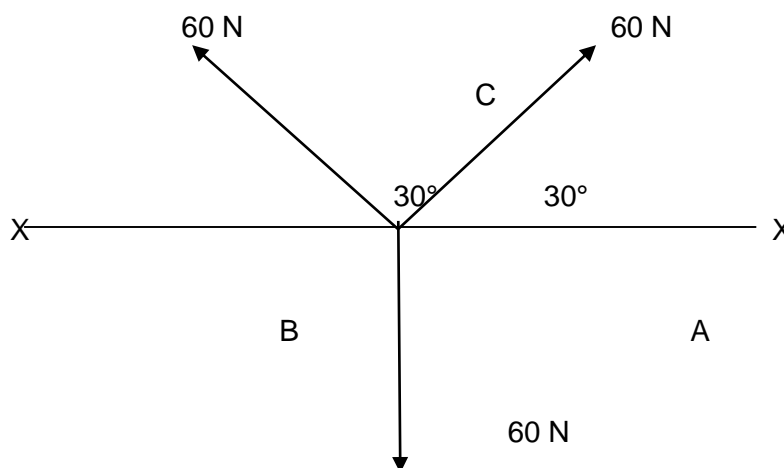
- 7.3 What is back firing with regard to oxy-acetylene welding? (2)
- [7]

QUESTION 8: FORCES (SPECIFIC)

- 8.1 A round mild steel bar, 100 mm long, with a diameter of 50 mm, is used in a steel framework. A compressive force of 60 kN is exerted on the bar and shorten by 0,4 mm.

Calculate the following:

- 8.1.1 The stress in the material and state your answer in mega pascals (5)
- 8.1.2 The strain caused by the force (3)
- 8.2 FIGURE 8.2 shows a system of forces acting on the same point. Use Bow's notation to construct a space diagram, depicting the lines of action and direction of all the forces in the system. Use the following scale with Bow's notation: 1 mm = 3 N



(3)

- 8.3 The beam in FIGURE 8.3 below is supported at two ends and is subjected to three point loads, 4 N, 5 N and 3 N respectively.

Calculate the reactions at the supports RL and RR.

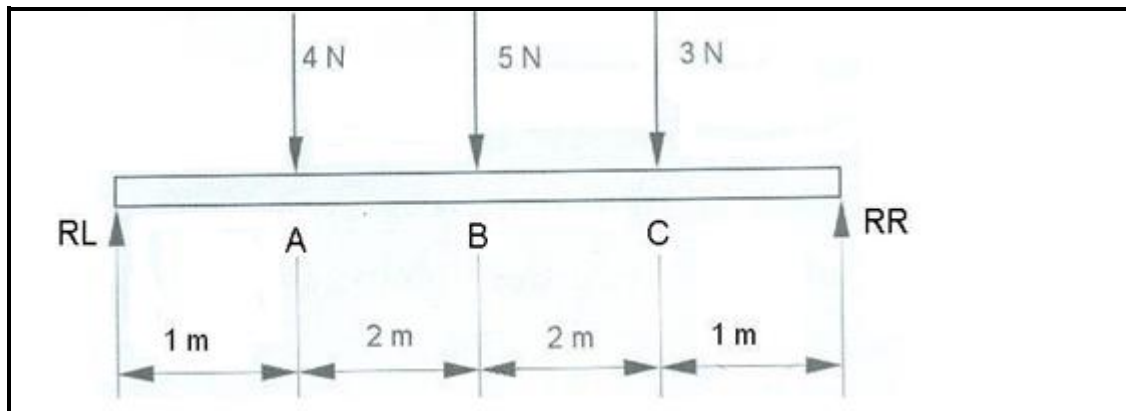


FIGURE 8.3

(6)
[17]

QUESTION 9: MAINTENANCE (SPECIFIC)

- 9.1 State an effect caused by the lack of lubrication on a manual guillotine. (2)



- 9.2 State TWO results of overloading of the punch and sheering machine. (2)

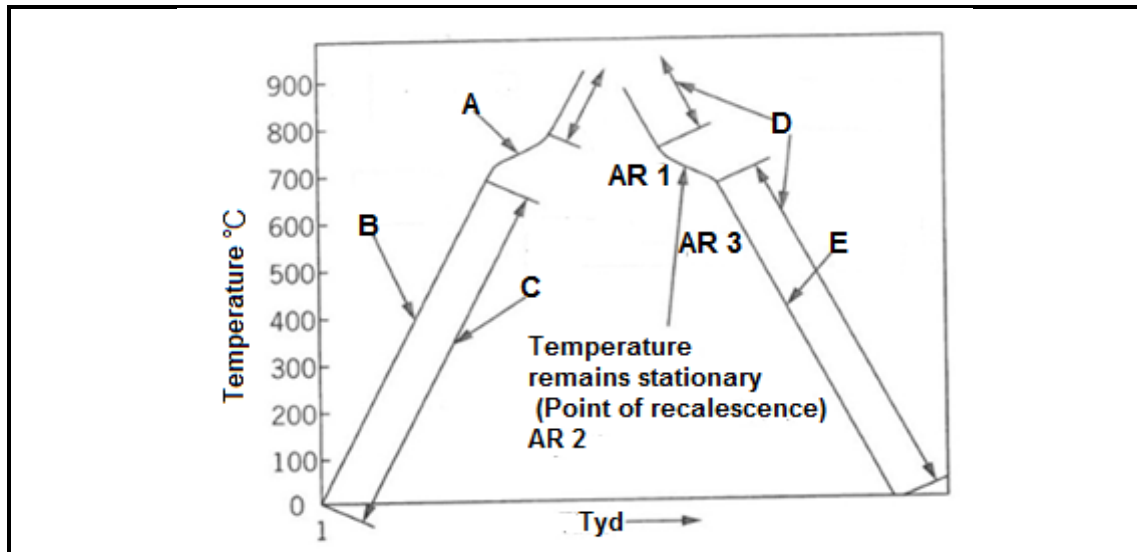
- 9.3 A well-maintained sheering machine has a longer lifespan, enhances production and reduces cost. State TWO factors that extend the service life of a machine effectively.



(2)
[6]

QUESTION 10: JOINING METHODS (SPECIFIC)

10.1 FIGURE 10.1 shows the heating and cooling curve for steel. Answer the questions that follow.



- 10.1.1 Label the parts marked **A–E**. (5 x 1) (5)
- 10.1.2 Mention **THREE** methods of heat treatment. (3)
- 10.2 Give the **THREE** different varieties of carbon steel used in engineering and the carbon content of each. (6)
- 10.3 Name any arc/gas welding defect. (1)
- [15]**

QUESTION 11: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)

11.1 Develop the right cylindrical Y-connection in FIGURE 11.1 below.

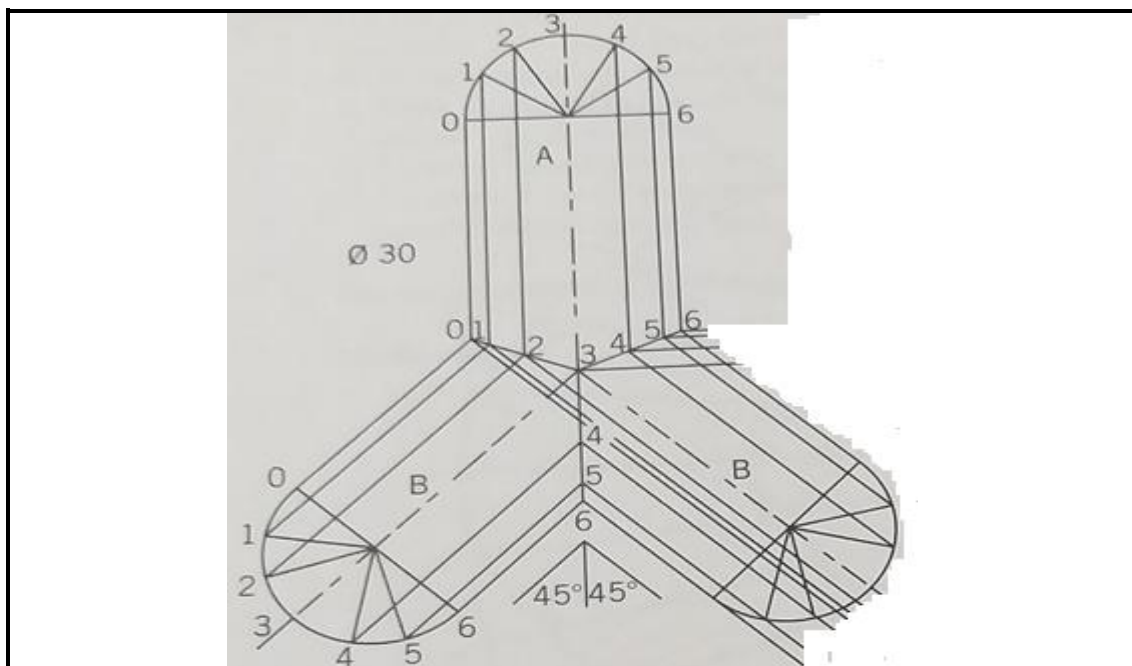


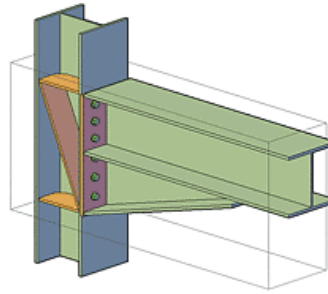
FIGURE 11.1

(19)
[19]

QUESTION 12: TERMINOLOGY (STEEL SECTIONS) (SPECIFIC)

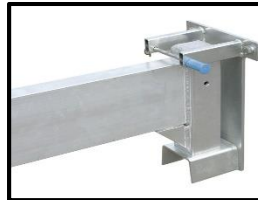
- 12.1 Name FOUR different steel sections that are used in structural work. (4)
- 12.2 What is a *steelmill*? (2)
- 12.3 What is meant by the term *notching*? (2)
- 12.4 Make a neat drawing of a column cap. (4)
- 12.5 Identify the following types of joints in steel-framed construction.

12.5.1



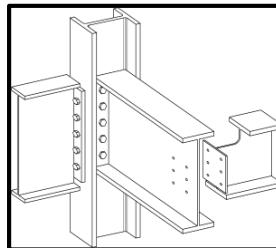
(1)

12.5.2



(1)

12.5.3



(1)

- 12.6 Identify the machine used in the cutting process below.



(1)

- 12.7 List TWO types of T-joints from steel profiles that can be notched and welded when joining similar or different sections of notching and welding. (2)

[18]**TOTAL: 200**

FORMULA SHEET FOR MECHANICAL TECHNOLOGY (WELDING AND METALWORK)

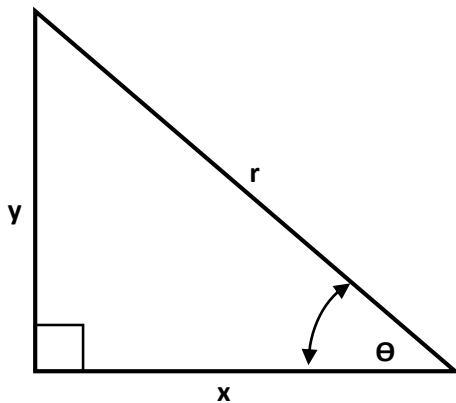
1. STRESS AND STRAIN

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

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

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

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

$$3.1 \quad \begin{aligned} \text{Mean } \phi &= \text{Outside } \phi - \text{Plate thickness} \quad \text{or} \\ \text{Mean } \phi &= \text{Inside } \phi + \text{Plate thickness} \end{aligned}$$

$$3.2 \quad \text{Mean circumference} = \pi \times \text{Mean } \phi$$