



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2020

**MECHANICAL TECHNOLOGY:
WELDING AND METALWORK
(EXEMPLAR)**

MARKS: 200

TIME: 3 hours

This question paper consists of 18 pages, including a 2-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 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.

MECHANICAL TECHNOLOGY – WELDING AND METALWORK GRADE 11			
SECTION A (GENERIC)			
QUESTION	CONTENT	PERCENTAGE	MARKS
	GENERIC		
1	Multiple-choice questions (8) Generics – (12) Specific	10%	20
2	Safety	10%	20
3	Tools and Equipment	10%	20
4	Materials	12,5%	25
	TOTAL:	42,5%	85

SECTION B: WELDING AND METALWORK (SPECIFIC)

MECHANICAL TECHNOLOGY – WELDING AND METALWORK GRADE 11			
SECTION B – (SPECIFIC)			
QUESTION	CONTENT	PERCENTAGE	MARKS
5	Maintenance	5%	10
6	Tools	10%	20
7	Forces	17,5%	35
8	Joining Methods – Terminology	7,5%	15
9	Joining Methods – Heat Treatment	7,5%	15
10	Joining Methods – Development	10%	20
		57,5%	115
		TOTAL:	200

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

- 1.1 Which ONE of the following safety procedures is applicable to the maintenance/operation of a hydraulic press?
- A Do not apply a 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)
- 1.2 Which ONE of the following safety procedures is applicable to the press machine?
- A Hold the material firmly to prevent the inaccurate cutting of material.
 - B Make sure not to exceed load 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 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 workplace is partitioned off.
 - C an operator uses protective equipment.
 - D All of the above. (1)
- 1.4 Which safety measure is applicable to guillotines in terms of the OHS Act?
- A Clamp the workpiece 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)
- 1.5 What is the maximum safe distance that the tool rest should be from a grinding wheel on a bench grinder?
- A 3 mm
 - B 3 m
 - C 8 mm
 - D 6 mm (1)

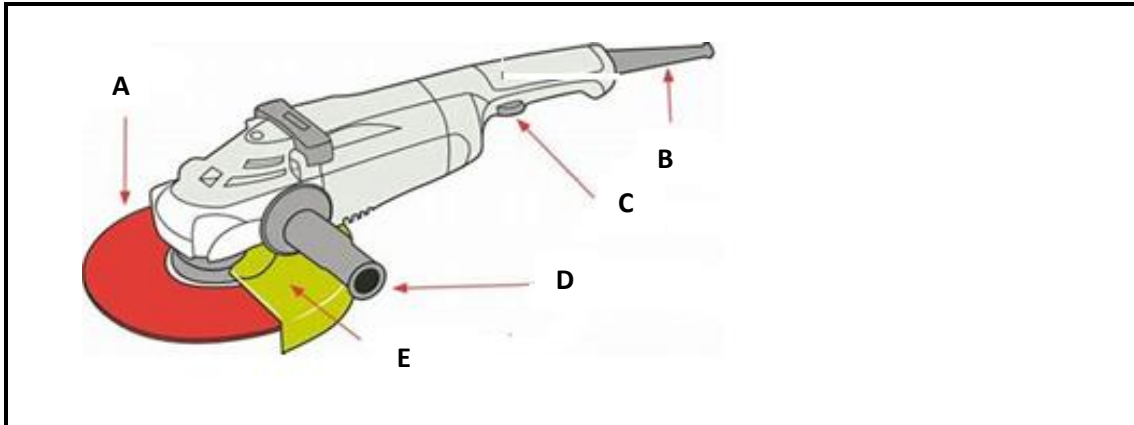
- 1.6 Which tool is used to cut or form internal threads of a nut?
- A Die
 - B Tap
 - C Gauge
 - D Stocks and dies
- (1)
- 1.7 The function of the drill press is to ...
- A drill holes in ferrous metals.
 - B drill holes in non-ferrous metals.
 - C drill holes in composite plastics.
 - D All of the above.
- (1)
- 1.8 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 ensure a straight cut.
 - D To move the blade forward and backwards.
- (1)
- 1.9 What is the function of the extension bars of a guillotine?
- A To enlarge the size of the material.
 - B To support the guards.
 - C To support longer pieces of material.
 - D To activate the foot pedal of the machine.
- (1)
- 1.10 Which ONE of the following is an incorrect function of an angle grinder?
- A Finishing
 - B Grinding
 - C Cutting
 - D Polishing
- (1)
- 1.11 Which ONE of the following tools is used for marking off?
- A Allen key
 - B Scriber
 - C Circlip plier
 - D Steel rule
- (1)
- 1.12 The following general guideline can be used when maintaining a pedestal drill machine. Choose the incorrect answer.
- A Lubricate moving component such as chuck according to manufacturer's specification.
 - B Lubricate the depth gauge according to manufacturer's specification.
 - C Verify that all guards are secure and function correctly.
 - D Visually check the main electrical switches and wiring for faults and arrange repairs.
- (1)

- 1.13 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)
- 1.14 When does overloading occur in a pedestal drill?
- A When the drill bit is forced into the material.
 - B When the chuck is forced into the material.
 - C When excessive force is applied on the machine.
 - D When the machine is moving fast. (1)
- 1.15 Maintenance of power saw includes, amongst others, to check ...
- A guide alignment.
 - B band speed.
 - C transmission oil level.
 - D All of the above. (1)
- 1.16 What is the cause of malfunction of power saw and pedestal drill?
- A Lubrication
 - B Maintenance
 - C Lack of lubrication or incorrect lubrication
 - D Lack of lubrication or correct lubrication (1)
- 1.17 What are the indicators that bearings of a pedestal grinder need to be replaced?
- A Excessive vibration
 - B Excessive friction
 - C Overloading
 - D Tool rest (1)
- 1.18 Which ONE of the following is the unit for measuring torque?
- A Newton
 - B Newton per metre
 - C Newton metre
 - D Newton per metre square (1)

- 1.19 Overloading in pedestal grinders can result in machine malfunctioning due to ...
- A excessive load on the spindle bearing.
 - B friction.
 - C power loss.
 - D bearings.
- (1)
- 1.20 Compressive stress can be defined or described as an internal force in a material resisting a ...
- A pulling load.
 - B pushing load.
 - C shearing load.
 - D pulling and shearing load
- (1)
[20]

QUESTION 2: SAFETY (GENERIC)

- 2.1 Name the TWO categories that the OHS is divided into. (2)
- 2.2 Identify the labels of the angle grinder as shown in FIGURE 2.2 below.

**FIGURE 2.2**

(5)

- 2.3 What are the main factors that need to be undertaken before welding or flame cutting operations? (3)
- 2.4 Gas cylinders should be labelled and identified. Name any FOUR important particulars needed to be visible on the cylinders. (4)
- 2.5 Give TWO basic rules that apply to machine guards in a workshop. (2)
- 2.6 State why workers should NOT wear loose clothing in a workshop. (2)
- 2.7 State ONE safety precaution you should observe before pressing a bearing from a shaft on a hydraulic press. (1)
- 2.8 State ONE safety rule one must adhere to before switching on a band saw. (1)

[20]

QUESTION 3: TOOLS (GENERIC)

3.1 Identify **A–C** on the illustration in FIGURE 3.1 below.

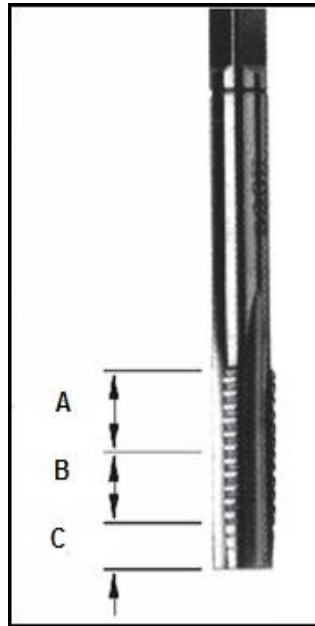


FIGURE 3.1

(3)

3.2 Discuss the precautions when using taps and dies. (3)

3.3 Why do pedestal drills have a depth gauge? (2)

3.4 What is a *surface grinder*? (1)

3.5 List THREE different cutting machines for cutting steel. (3)

3.6 Why should a guillotine blade be adjustable? (1)

3.7 Describe the working principle of a guillotine. (3)

3.8 What should be checked before using a grinder? (2)

3.9 What type of blades can be used on an angle grinder? (2)

[20]

QUESTION 4: MATERIALS (GENERIC)

4.1 Describe the following terms with regard to the properties of metals:

4.1.1 Toughness (2)

4.1.2 Elasticity (2)

4.1.3 Malleability (2)

4.2 What is the difference between *iron ore* and *pig-iron*? (4)

4.3 Describe how a blast furnace is charged. (5)

4.4 Identify the labels of the rotor plant (furnace) as shown in FIGURE 4.4 below.

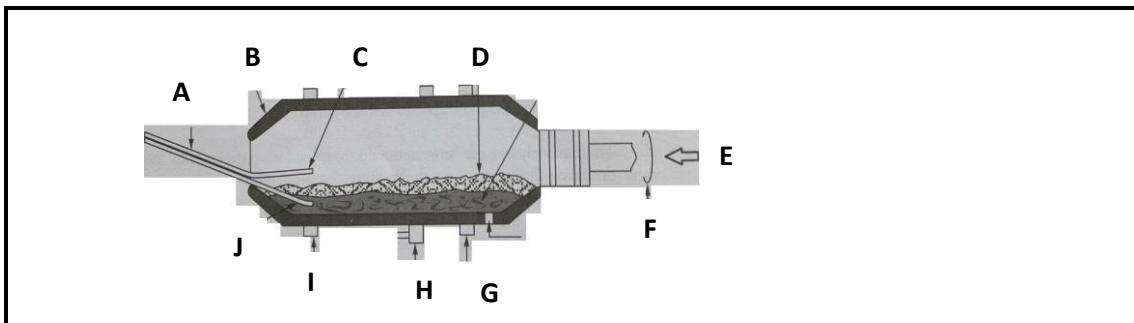


FIGURE 4.4

(10)

[25]

QUESTION 5: MAINTENANCE (SPECIFIC)

5.1 What would the effect of excessive friction be when holes are being drilled on a pedestal drill press? (2)

5.2 Do bench grinders need to be lubricated? Motivate your answer. (2)

5.3 Give TWO examples of machines where friction is not a relative factor. (2)

5.4 What are the effects of preventive maintenance on power saws? (2)

5.5 State TWO safety precautions that you should ensure when locking out and tagging a large power machine before inspection or doing maintenance. (2)

[10]

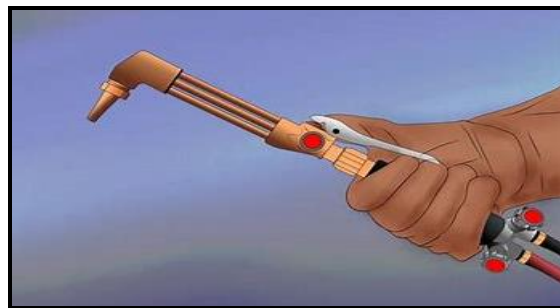
QUESTION 6: TOOLS AND EQUIPMENT(SPECIFIC)

6.1 Describe the function of a punching machine.



(2)

6.2 State TWO advantages of a plasma cutter compared to an oxy-acetylene cutter.



(2)

6.3 Describe the principles of arc welding.

(3)

6.4 Which type of material is best suited for cutting with a cut-off machine?

(1)

6.5 Identify the labels (A–J) of the oxy-acetylene equipment in FIGURE 6.5 below.

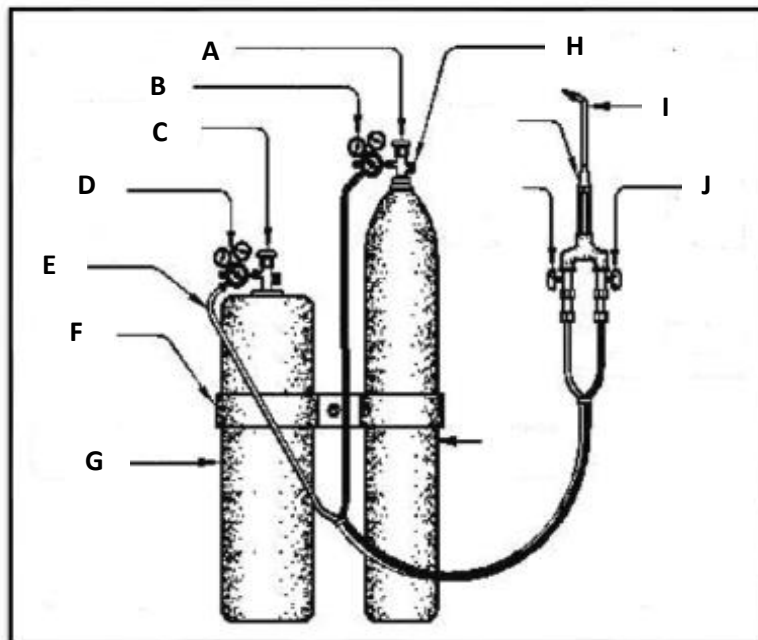


FIGURE 6.5

(10)

6.6 Identify the machine in FIGURE 6.6 below.



FIGURE 6.6

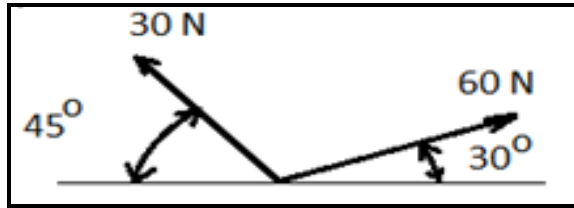
(1)

6.7 What is the purpose of this machine?

(1)
[20]

QUESTION 7: FORCES (SPECIFIC)

7.1 Resolve the following forces into horizontal and vertical components.

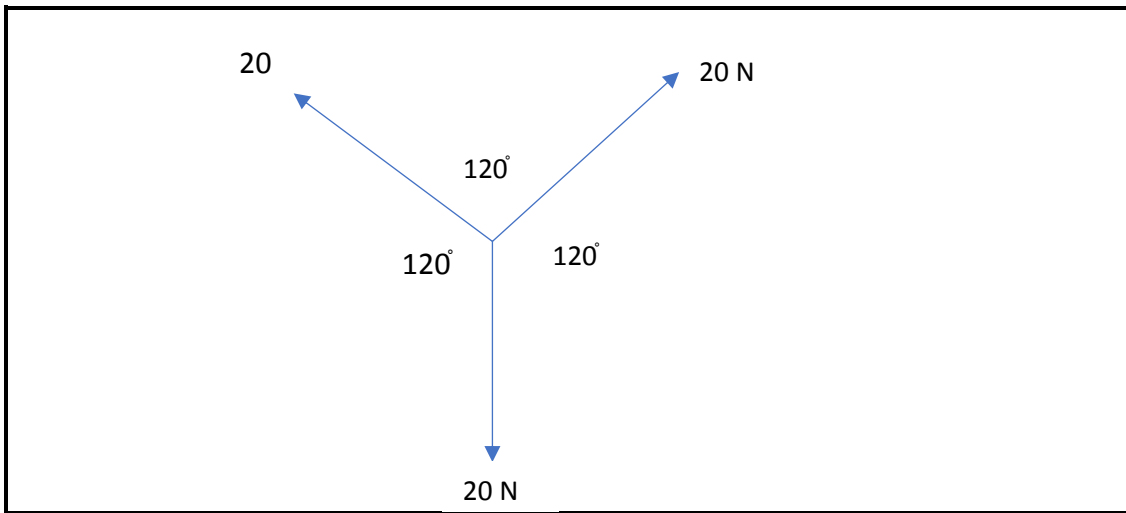


(6)

7.2 Construct a triangle of forces, using Bow's notation and show how the forces are in equilibrium.

Hint: Draw the space diagram and then the force diagram.

Force diagram – Scale 4 cm = 10 N



(6)

7.3 FIGURE 7.3 below shows a power system. Calculate the following:

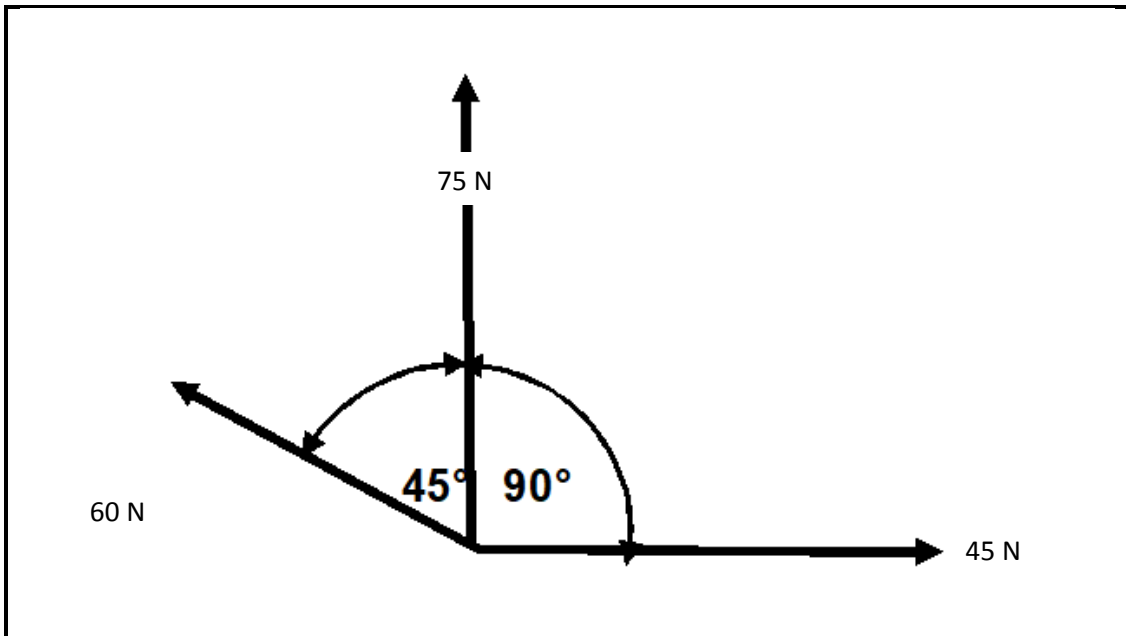


FIGURE 7.3

7.3.1 The resultant of the horizontal components

(3)

7.3.2 The resultant of the vertical components

(3)

- 7.4 FIGURE 7.4 below shows a beam that is supported by two vertical supports RL and RR. Two vertical point loads 40 N and 60 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.

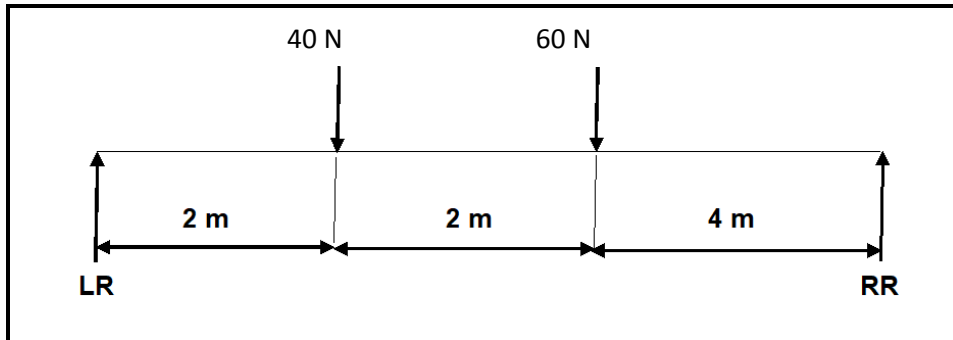


FIGURE 7.4

(6)

- 7.5 A tensile force of 50 kN is exerted onto a round bar with a diameter of 50 mm and an original length of 3 m.

Calculate the stress in the material.

(5)

- 7.6 Young's modulus for brass is 8.96×10^{11} Pa. A 120 N weight is attached to an 8 m length of brass wire. Find the increase in length if the diameter is 1,5 mm.

(6)

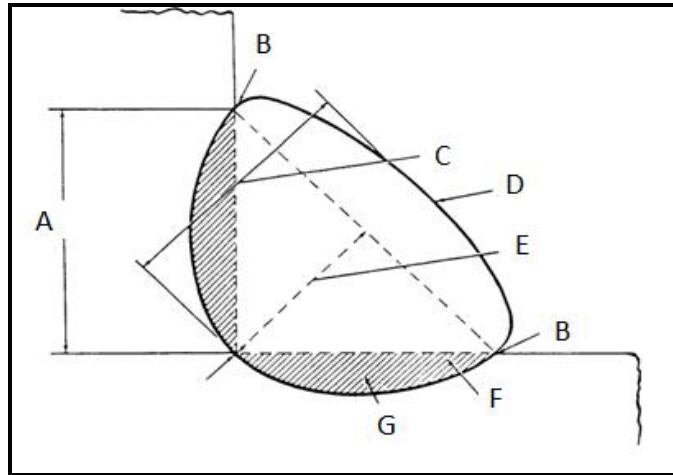
[35]

QUESTION 8: WELDING TERMINOLOGY (SPECIFIC)

8.1 What is a *template*? (2)

8.2 Define the term *backmark* as used in a fabrication workshop. (2)

8.3 Identify the labels (A–G) as depicted in the illustration below.



(7)

8.4 Explain the following supplementary symbols by means of sketches.

8.4.1 Concave (1)

8.4.2 Flush (1)

8.5 Identify the following fusion welding symbols below:

8.5.1  (1)

8.5.2  (1)

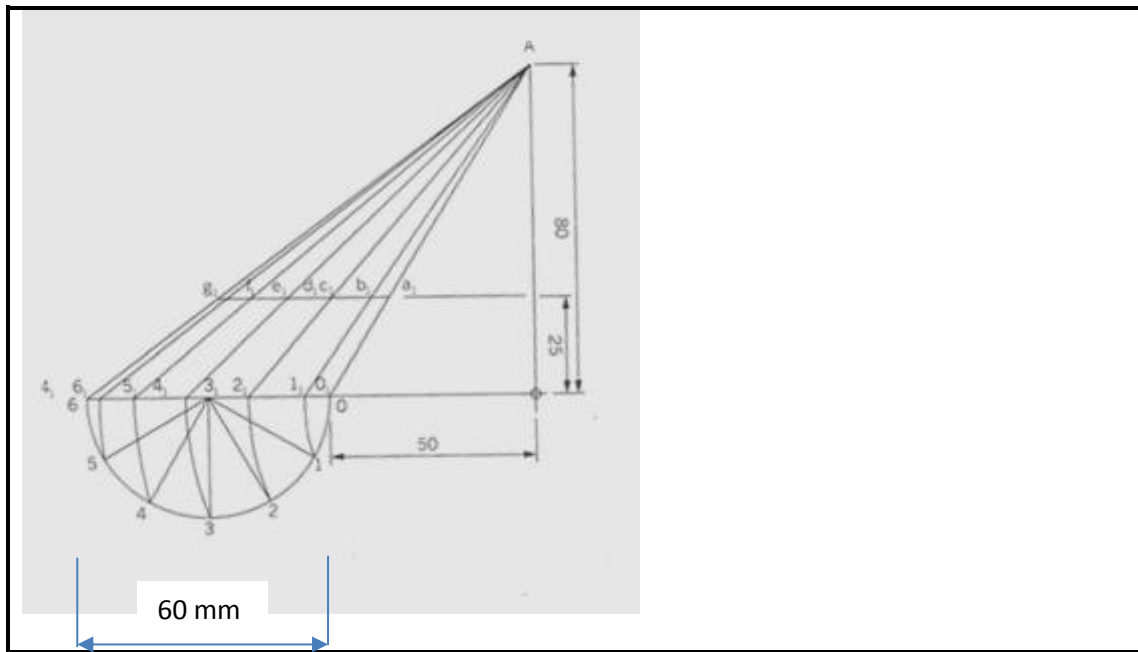
(1)
[15]

QUESTION 9: JOINING METHODS (HEAT TREATMENT) (SPECIFIC)

- 9.1 Name THREE types of welding joints that require filler material to create the correct weld shape and strength. (3)
 - 9.2 By means of a sketch, draw a butt-weld that needs to be tack welded together to prevent distortion. (2)
 - 9.3 Explain how to strike an arc during the arc welding process. (3)
 - 9.4 What are the FOUR main things that need to be controlled by a welder to run a good bead? (4)
 - 9.5 State THREE factors that reduce and increase the hardness when welding carbon steel. (3)
- [15]**

QUESTION 10: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)

- 10.1 Develop the truncated oblique cone as shown below. The vertical height is 80 mm. The cone is cut 25 mm above the baseline and the diameter is 60 mm.



[20]

TOTAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY (WELDING AND METALWORK)

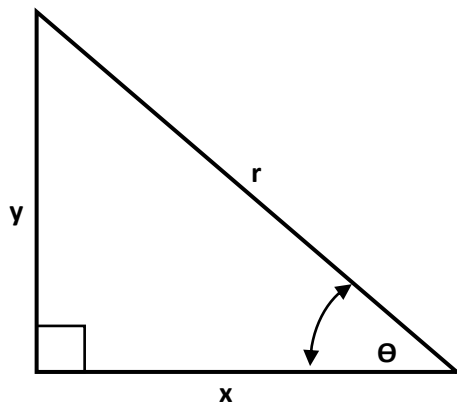
1. STRESS AND STRAIN

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

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

$$1.3 \quad \text{Strain} = \frac{\text{Change in length}}{\text{Original length}} \quad \text{or} \quad \varepsilon = \frac{\Delta l}{l_0}$$

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 $\phi = \text{Outside } \phi - \text{Plate thickness}$ or
Mean $\phi = \text{Inside } \phi + \text{Plate thickness}$

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

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