education

Department:
Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE

## GRADE 11

## MECHANICAL TECHNOLOGY

## EXEMPLAR 2007

**MARKS: 200**

**TIME: 3 hours**

**This question paper consists of 18 pages.**

## INSTRUCTIONS AND INFORMATION

1. Write your examination and centre number in the spaces provided on the answer book.
2. Answer ALL the questions.
3. Read ALL the questions carefully.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Write neatly and legibly.
6. Show ALL the calculations and units.
7. The value of gravitational force should be taken as 10 $m/s^2$.
8. Use the criteria below to assist you in managing your time:

| Question | Assessment Standards | Content covered | Marks | Time |
|---|---|---|---|---|
| 1 | 1 – 9 | Multiple-choice questions | 20 | 18 minutes |
| 2 | 6 and 8 | Applied Mechanics | 50 | 45 minutes |
| 3 | 2 | Tools and Equipment | 20 | 18 minutes |
| 4 | 3 | Materials | 20 | 18 minutes |
| 5 | 1, 4 and 5 | Manufacturing Process, Construction Methods and Safety | 50 | 45 minutes |
| 6 | 7 and 9 | Pumps and Maintenance | 40 | 36 minutes |
| **TOTAL** | | | **200** | **180 minutes** |

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**
**(Learning Outcome 3: Assessment Standards 1 – 9)**

Various possible options are provided as 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 the answer book, for example 1.21 E.

1.1 Which of the following safety aspects is not the responsibility of the employee?

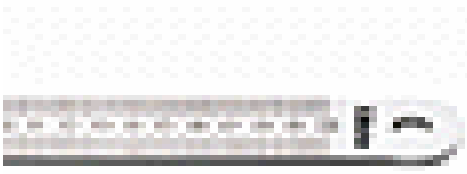
A Sufficient lightning
B Responsible use of tools and equipment
C Correct clothing
D Clean and neat working environment (1)

1.2 Which TWO types of safety equipment are used when working on a lathe?

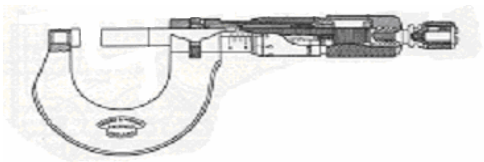
A Helmet and goggles
B Aprons and gloves
C Safety shoes and goggles
D Gloves and goggles (1)

1.3 Which ONE of the tools shown below is used for precision measuring the diameter of a round bar?

**A**



**C**



**B**


**D**

**FIGUUR 1.1** (1)

1.4 What is the reading on the micrometer scale shown in FIGURE 1.2?

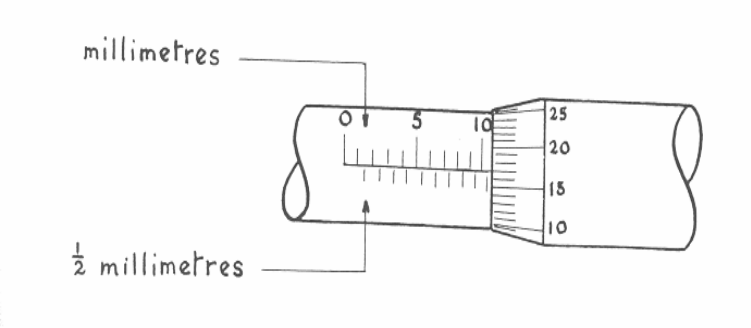



**FIGURE 1.2**

A 10,76 mm
B 10,67 mm
C 10,17 mm
D 10,71 mm (1)

1.5 Which of the following statements is a description of annealing?

A Restoring metal to its softest state
B Shaping of metal by hammer when red hot
C Removing some of the brittleness after hardening (1)
D Producing maximum hardness

1.6 The process of relieving stresses set up by cold working is termed …

A casting.
B hardening.
C tempering.
D normalising. (1)

1.7 Identify the component of the lathe shown in FIGURE 1.3.

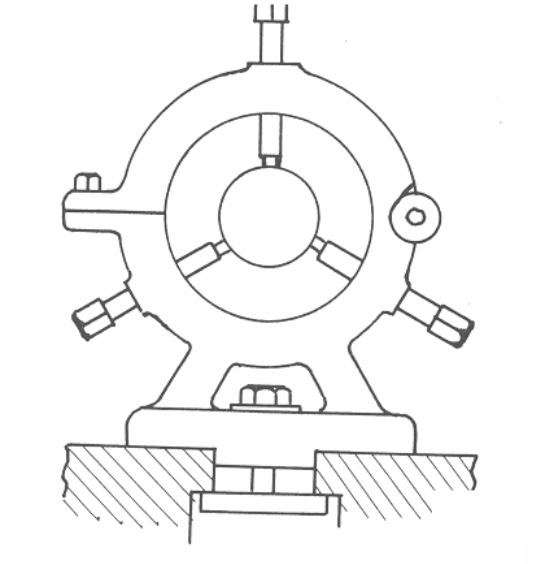


**FIGURE 1.3**

A Tool post
B Compound slide
C Fixed steady
D Travelling steady (1)

1.8 Which machine process is illustrated in FIGURE 1.4?

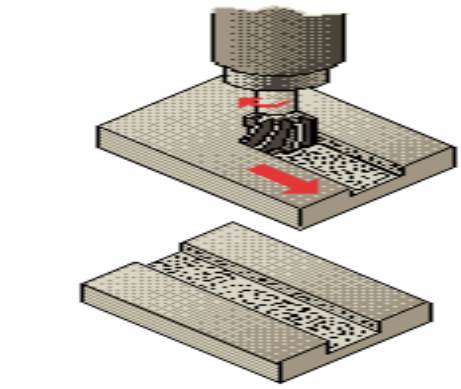


**FIGURE 1.4**

A Milling machine
B Shaping machine
C Grinding machine
D Drilling machine (1)

1.9 Identify the welding symbol for a fillet joint from the ones given below:

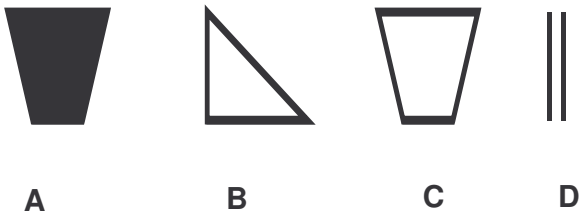



**FIGURE 1.5** (1)

1.10 Identify the type of welding joint shown in FIGURE 1.6.

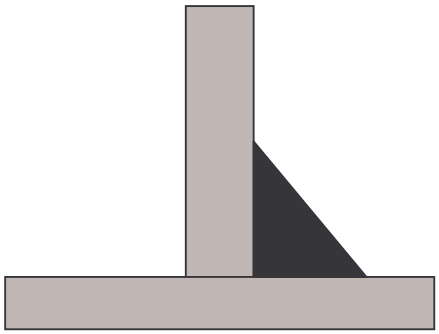


**FIGURE 1.6**

A Bevel joint
B Lap joint
C Butt joint
D T-joint (1)

1.11 What concept describes 'tie' the best?

A A pulling force
B A shearing force
C A pushing force
D A tearing force (1)

1.12 What is the unit measure for torque?

A Newton
B Pascal
C Newton metre
D Newton per metre

(1)

1.13 Which of the following describes the importance of lubrication?

A Dissipate heat
B Reduce friction
C Cool engine
D All the above-mentioned (1)

1.14 The main reason for maintenance of mechanical equipment is ...

A to stop using machinery regularly.
B to increase the lifespan of the equipment.
C to operate at high speed.
D to operate at average speed. (1)

1.15 Which of the following statements results in the malfunctioning of a bearing?

A Damaged oil seal
B Too much grease
C Too much oil
D None of the above-mentioned (1)

1.16 What type of linkage is shown in FIGURE 1.7? (Propulsion from the crank.)

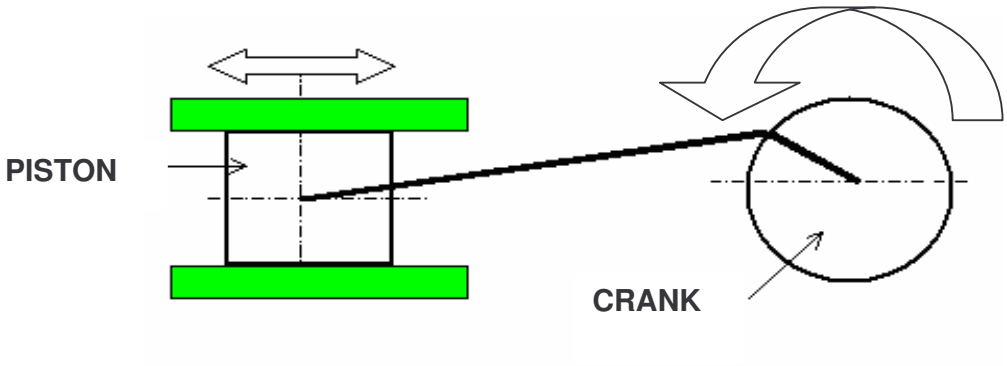



**FIGURE 1.7**

A Bell crank motion
B Reverse motion
C Parallel motion
D Forward motion (1)

1.17 A block and tackle is an example of a ...

A pulley system.
B chain drive.
C gear system.
D All the above-mentioned (1)

1.18 What is the purpose of using a cable in a vehicle?

A Operate the accelerator
B Operate the clutch
C Operate the boot lid
D All the above-mentioned (1)

1.19 A flexible impeller pump is an example of a ...

A centrifugal pump.
B reciprocating pump.
C multistage pump.
D rotary pump. (1)

1.20 What is the purpose of the strainer in a centrifugal pump?

A Prevents the pump from drawing in dirt
B Increases the pressure of the pump
C Increases the volume of the water inside the pump casing
D Decreases the thickness of the oil in the pump system

(1)
**[20]**

**QUESTION 2: APPLIED MECHANICS**
**(Learning Outcome 3: Assessment Standards 6 and 8)**

2.1 FIGURE 2.1 shows a beam with forces acting upon it.

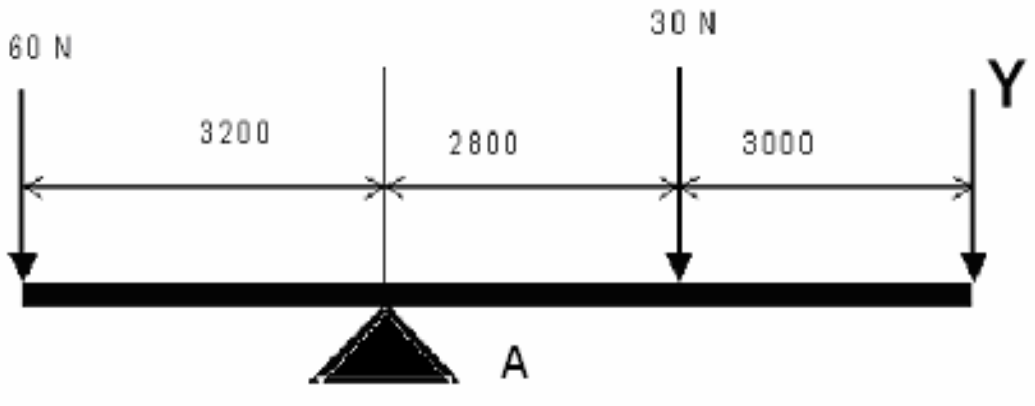



**FIGURE 2.1**

2.1.1 Calculate the magnitude of the unknown force Y to balance the beam. (5)

2.1.2 Calculate the load on the support A. (2)

2.2 The Molopo river flows between Sejankabo High School and Seweding village. When the river is flooded the learners have to walk a long distance using the alternative route. The diagram below is of a bridge used to cross the river. The maximum mass that the bridge can carry at any given moment is 250 kilogram.

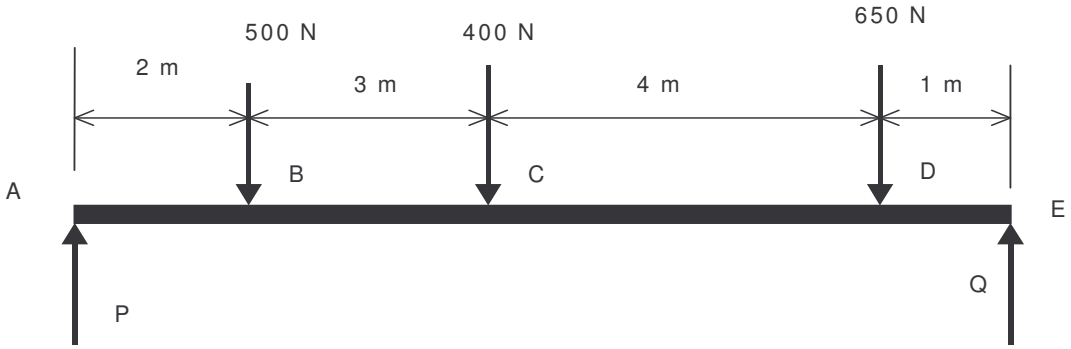



**FIGURE 2.2**

2.2.1 Prove, by means of calculations, that the bridge is safe to be used by the learners. (6)

HINT: Calculate the magnitudes of the reactions at supports P and Q.

2.2.2 Draw the shear force diagram using a scale of 1 mm = 10 N. (7)

2.3 FIGURE 2.3 indicates different gear drives.

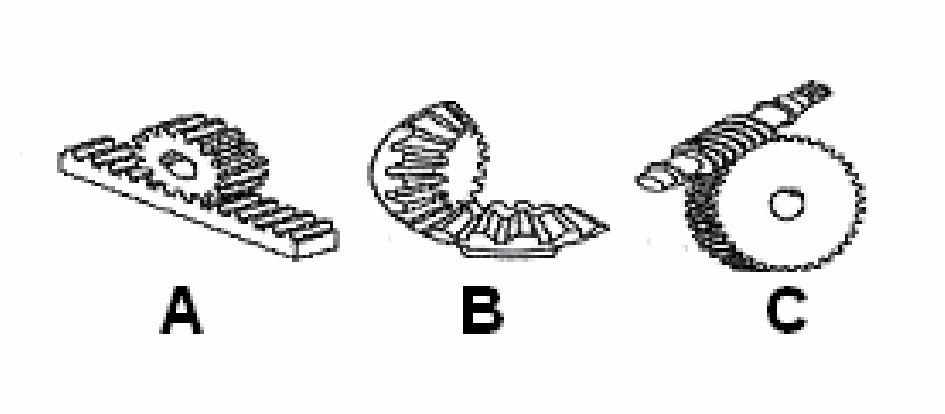



**FIGURE 2.3**

2.3.1 Identify gear drives A, B and C. (3)

2.3.2 Briefly explain the application of each gear drive. (6)

2.4 FIGURE 2.4 shows a line diagram of a basic lifting machine.

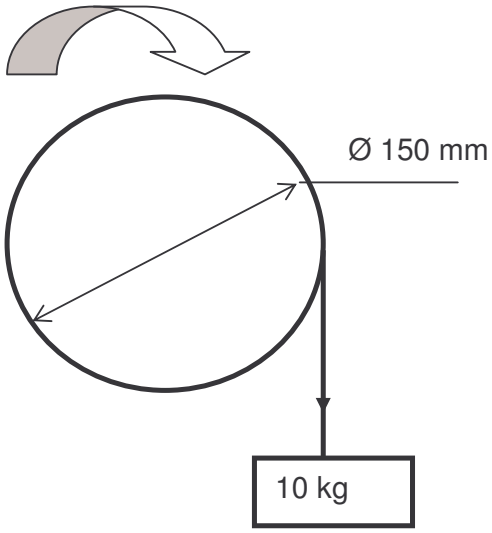



**FIGURE 2.4**

Calculate the torque of the system shown above. (10)

2.5 FIGURE 2.5 shows a brake system which is used in the industry to brake the rotating shaft of an overhead crane. Electricity is used to ensure that the system is functioning effectively. No pneumatic or hydraulic principles are applied to stop the rotating shaft.

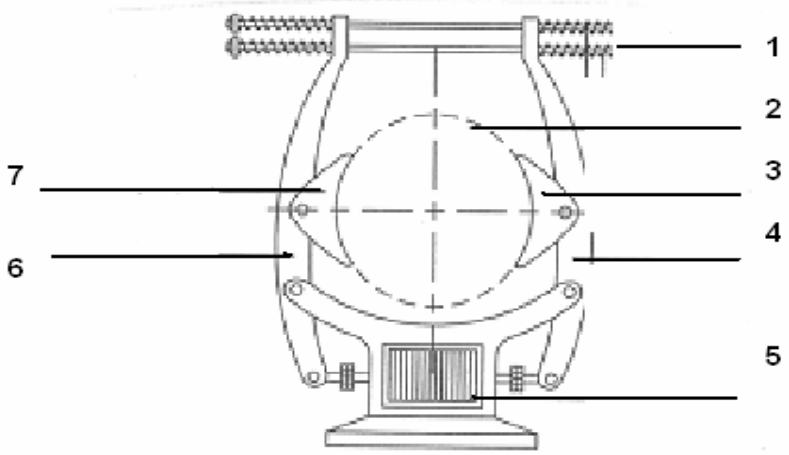



**FIGURE 2.5**

2.5.1 What type of braking system is illustrated in FIGURE 2.5? (Indicate the principle of electricity used.) (2)

2.5.2 List the parts numbered 1 to 7. (7)

2.5.3 State TWO advantages of the above system. (2)
**[50]**

**QUESTION 3: TOOLS AND EQUIPMENT**
**(Learning Outcome 3: Assessment Standards 2)**

3.1 FIGURE 3.1 shows the precision tool to indicate any variations that you cannot see with the naked eyes. One of its functions is to help the operator to set up a workpiece concentric in a lathe.

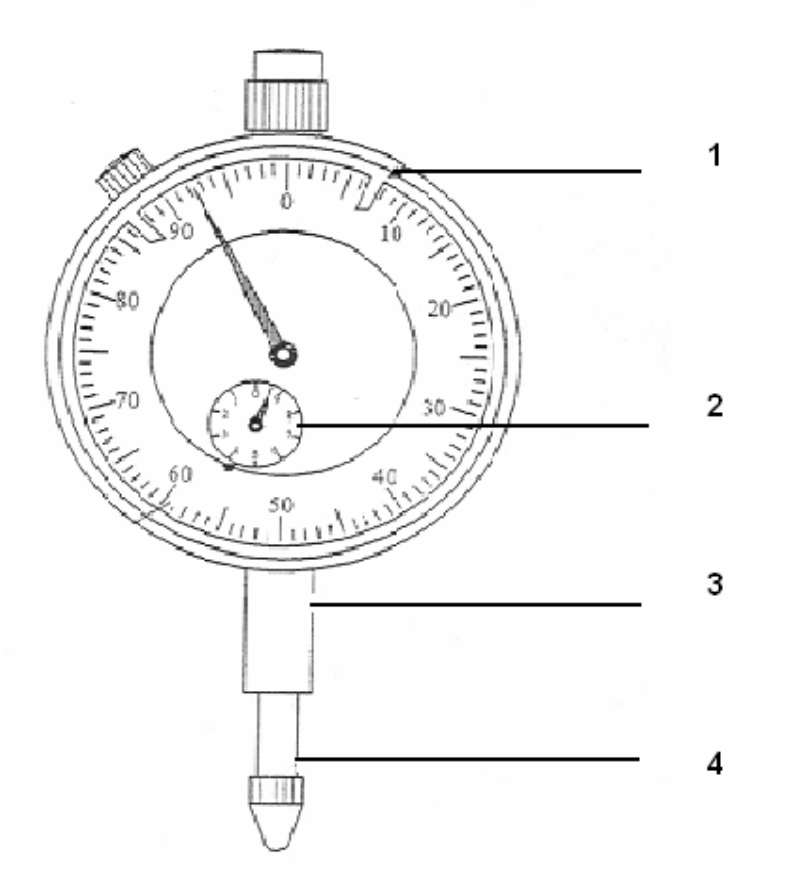



**FIGURE 3.1**

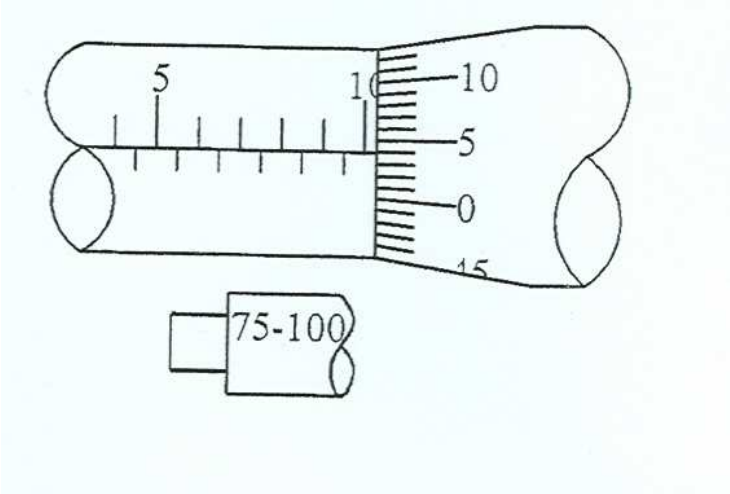
3.1.1 Identify the precision tool represented in FIGURE 3.1. (2)

3.1.2 State TWO functions of the above tool except the one already given. (2)

3.1.3 Label the parts numbered 1 to 4. (4)

3.2 Dies are used to do external screw cutting on a round bar or a shaft. State TWO working procedures when screw cutting is done by hand on a workbench. (2)

3.3 What is the measurement for the inside micrometer reading shown in FIGURE 3.2 when a 75 mm - 100 mm extension shaft is used?




(2)

**FIGURE 3.2**

3.4 Use FIGURE 3.3 to assist you to write down steps to be carried out when using a star wheel dresser to dress the grinding wheel.

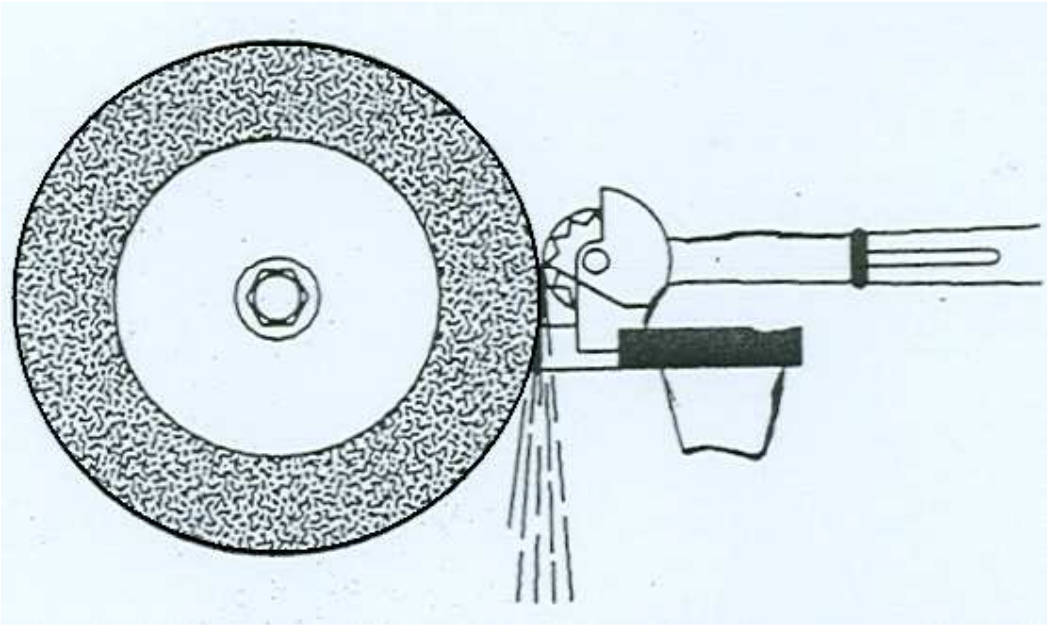


**FIGURE 3.3**

(8)
**[20]**

**QUESTION 4: MATERIALS**
**(Learning Outcome 3: Assessment Standards 3)**

4.1 Choose a definition from COLUMN B that matches a property in COLUMN A. Write only the letter (A - D) next to the question number (4.1.1 - 4.1.4) in the answer book, for example 4.1.5 E.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 4.1.1 | Hardness | **A** | metal deforms under load and does not return to its original shape when the load is removed |
| 4.1.2 | Plasticity | **B** | resists abrasion and penetration |
| 4.1.3 | Conductivity | **C** | withstands shock loads without fracture |
| 4.1.4 | Toughness | **D** | the ability of a material to conduct heat or electricity |

(4)

4.2 Properties of metal can be enhanced by certain processes. Explain the following processes and the procedures that are followed to achieve the outcome:

4.2.1 Annealing (6)

4.2.2 Case hardening (5)

4.2.3 Tempering (5)

**[20]**

**QUESTION 5: MANUFACTURING PROCESS, CONSTRUCTION AND SAFETY (Learning Outcome 3: Assessment Standards 1, 4 and 5)**

5.1 You are given the task to make a work piece using a metal lathe machine. List FIVE safety precautions to be observed when using a centre lathe.

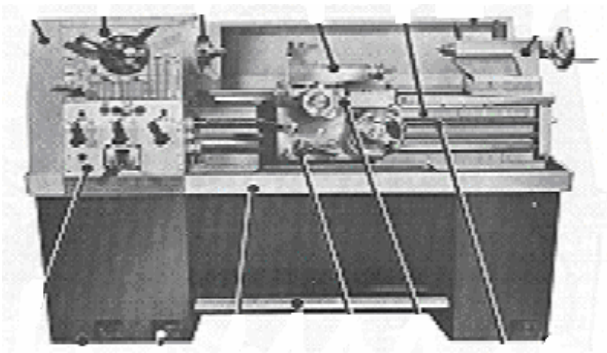


**FIGURE 5.1** (5)

5.2 Symbols is an international language. These symbols indicate to people of different cultures and language groups, the type of welding to be carried out on the joint. Use sketches and symbols to indicate the following welded joints:

5.2.1 Square butt joint (2)

5.2.2 Double-v-butt joint (2)

5.2.3 Single-J-butt joint (2)

5.2.4 Double-U-butt joint (2)

5.2.5 Fillet weld on T-joint (2)

5.3 What is the difference between soft- and hard-soldering? (4)

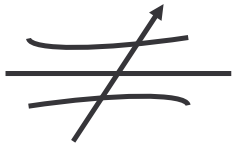
5.4 State TWO reasons for using a flux when brazing. (2)

5.5 Explain the method of operating oxy-acetylene apparatus.


**FIGURE 5.2** (9)

5.6 Name the pneumatic and hydraulic system symbols shown below:

5.6.1

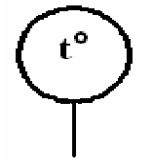


(1)

5.6.2

(1)

5.6.3




(1)

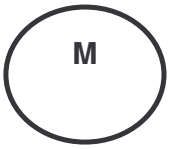
5.6.4


(1)

5.6.5

(1)

5.6.6




(1)

5.6.7

(1)

5.7 You are required to machine an M12 x 2 bolt in the Mechanical Technology workshop using a centre lathe. The diameter of the mild steel rod to be used is 20 mm.

5.7.1 Explain the specifications: M12 x 2 (3)

5.7.2 State TWO advantages of a three jaw chuck. (2)

5.7.3 Use neat, labelled sketches to indicate the cutting angles of a cutting tool to cut the diameter of the shaft down from 20 mm to 12 mm. (3)

5.7.4 Which physical settings need to be in place on the lathe to ensure that the screw thread can be cut? (5)

**[50]**

**QUESTION 6: PUMPS AND MAINTENANCE**
**(Learning Outcome 3: Assessment Standards 7 and 9)**

6.1 The most common pump known to all of us is the bicycle pump. Its main purpose is to inflate a flat tyre. What will be the function of mechanical pumps? (1)

6.2 Name THREE main categories of pumps. (3)

6.3 FIGURE 6.1 shows the volute casing of a centrifugal pump. Label the parts marked 1 to 4.

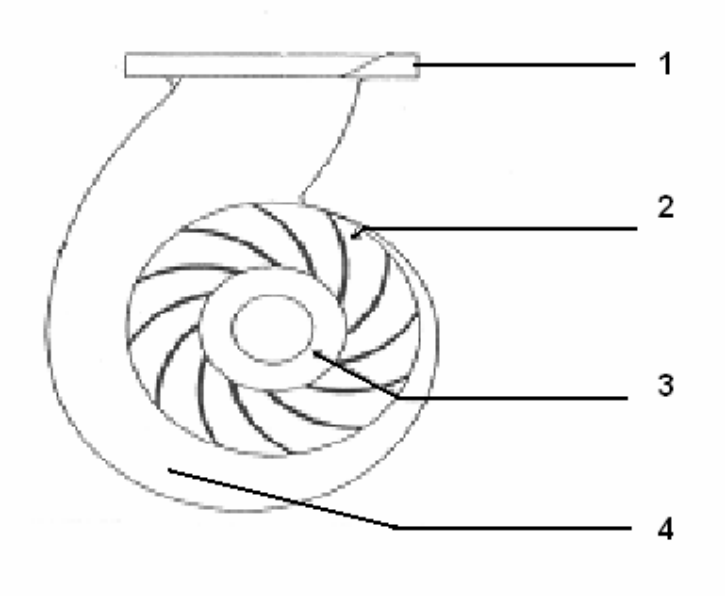



**FIGURE 6.1** (4)

6.4 Explain the following lubrication terms:

6.4.1 Viscosity (2)

6.4.2 Burning point (2)

6.4.3 Flash point (2)

6.5 FIGURE 6.2 shows a single-acting pump.

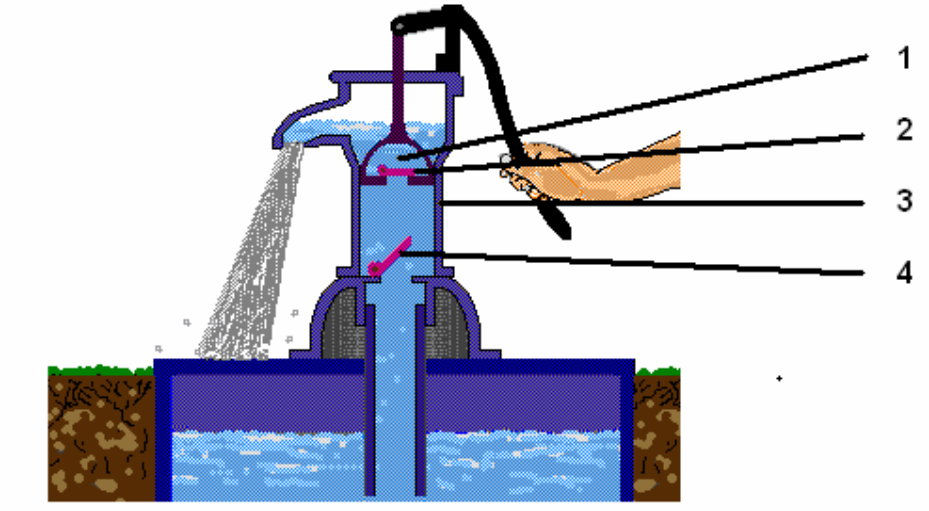



**FIGURE 6.2**

6.5.1 Label the parts numbered from 1 to 4. (4)

6.5.2 Describe the difference between single-acting and double-acting piston pumps. (4)

6.6 Describe how a gear pump operates. (5)

6.7 Calculate the pressure induced in the water pump if the height of the volute casing is 500 mm.

HINT: Pressure = density x gravitational force x height
Density of water = 1 000 kg/m$^3$. (3)

6.8 If the pump mentioned in QUESTION 6.6 is used to pump oil, will a higher or lower pressure be induced in the volute casing? Motivate your answer. (2)

6.9 Briefly explain the following concepts:

6.9.1 Wear (2)

6.9.2 Overheating (2)

6.9.3 Distortion (2)

6.9.4 Friction (2)

**[40]**

**TOTAL: 200**