Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2019

**MECHANICAL TECHNOLOGY:
FITTING AND TURNING**

MARKS: **200**

TIME: **3 hours**

IMCHTE3

This question paper consists of 19 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.

| QUESTION	CONTENT	MARKS	TIME in minutes
GENERIC			
1	Multiple-choice Questions	20	18
2	Safety	24	22
3	Tools and Equipment	16	14
4	Maintenance	8	7
5	Materials	32	29
SPECIFIC			
6	Terminology	25	23
7	Tools and Equipment	8	7
8	Forces	19	17
9	Maintenance	8	7
10	Joining Methods	12	11
11	Systems and Controls	16	14
12	Pumps	12	11
	TOTAL:	**200**	**180**

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 number (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?
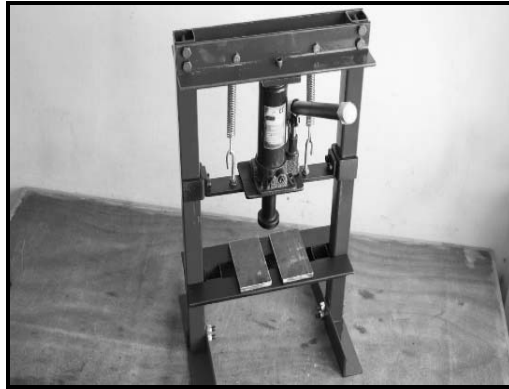
FIGUUR 1.2

     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 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 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 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 moist
     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?
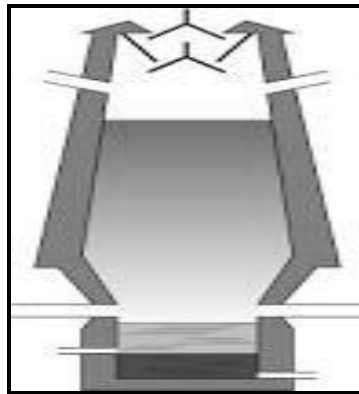
FIGURE 1.16

    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.
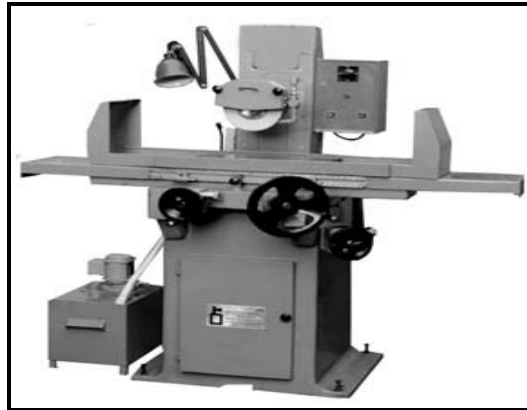
FIGURE 2.3   (3)

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.
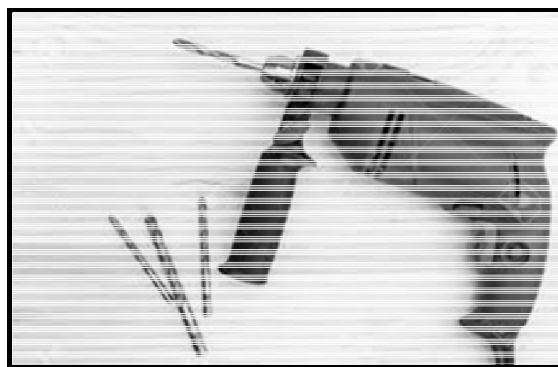
FIGURE 2.7   (3)

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 AND EQUIPMENT (GENERIC)

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

<div align="center">
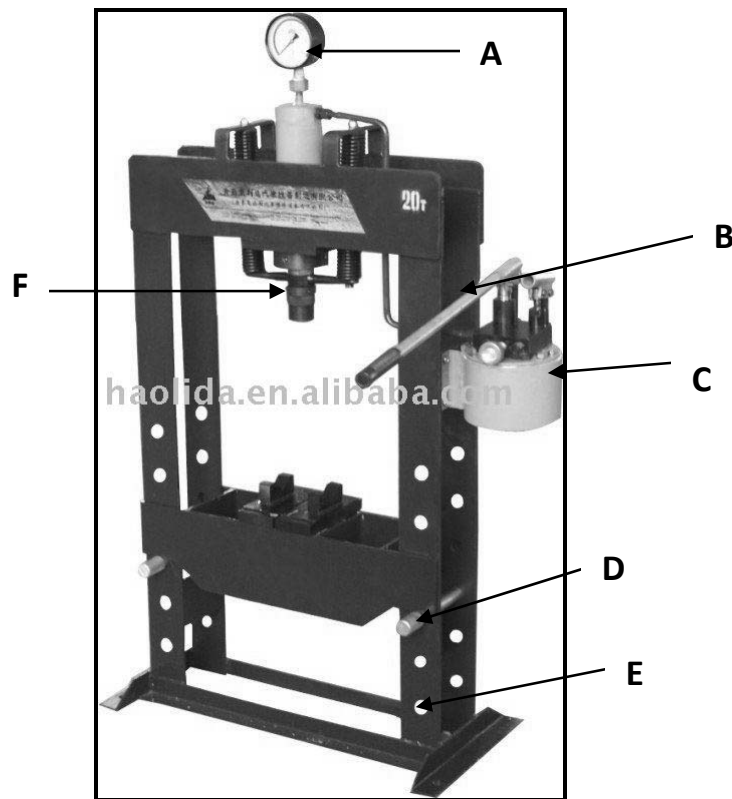
FIGURE 3.1   (2)
</div>

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.**

<div align="center">

FIGURE 3.3: HAND-OPERATED HYDRAULIC PRESS   (6)
</div>

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)

<div align="right">

[16]
</div>

QUESTION 4: MAINTENANCE (GENERIC)

4.1   Explain 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.
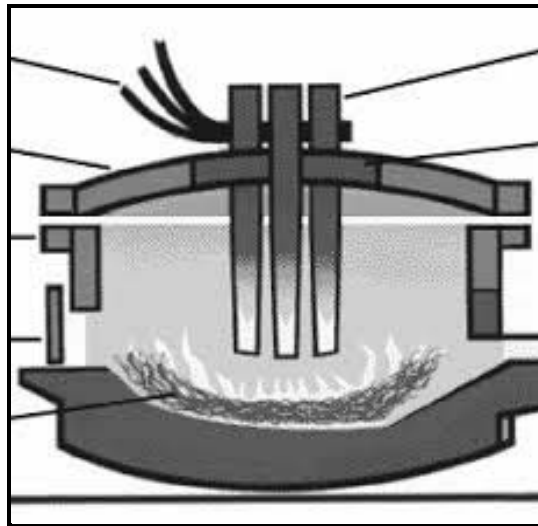
FIGURE 5.3   (3)

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)

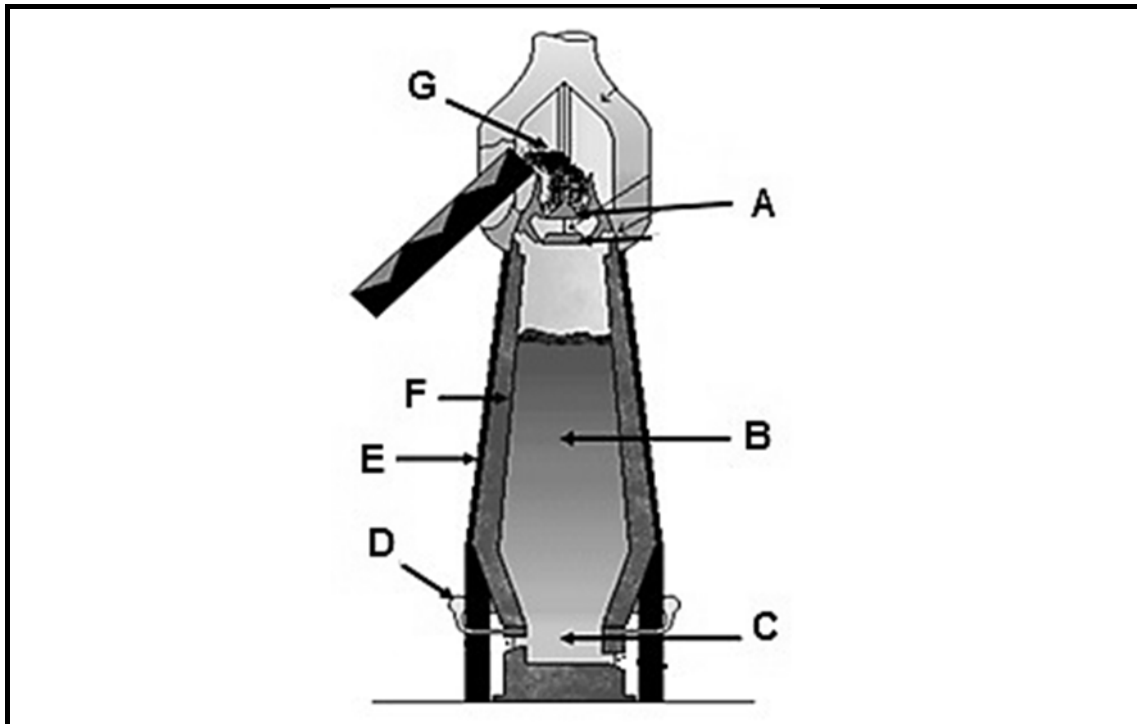5.5   FIGURE 5.5 below shows the cross-sectional view of a furnace.

FIGURE 5.5

    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: TERMINOLOGY (SPECIFIC)

6.1	Give the function of EACH of the following types of equipment on a centre lathe:

6.1.1	Tool post	(2)

6.1.2	Tail-stock	(1)

6.1.3	Lead screw	(1)

6.2	A 55 mm diameter shaft, 450 mm overall length, must be taper-turned with an included angle of 8,5° for a length of 205 mm. Calculate the small diameter of the taper.	(5)

6.3	Determine the depth of a 10 mm metric V-screw thread with a pitch of 1 mm.	(2)

6.4	List any THREE milling machine cutters generally used during milling operations.	(3)

6.5	A 15 mm wide key must be cut on a shaft 60 mm in diameter. Sketch and describe how a 15 mm wide side and face cutter can be centred on the shaft to cut the keyway.	(6)

6.6	Describe the difference between a *horizontal* and a *vertical milling machine*.	(2)

6.7	Calculate the indexing for the following:

6.7.1	25 divisions	(3)
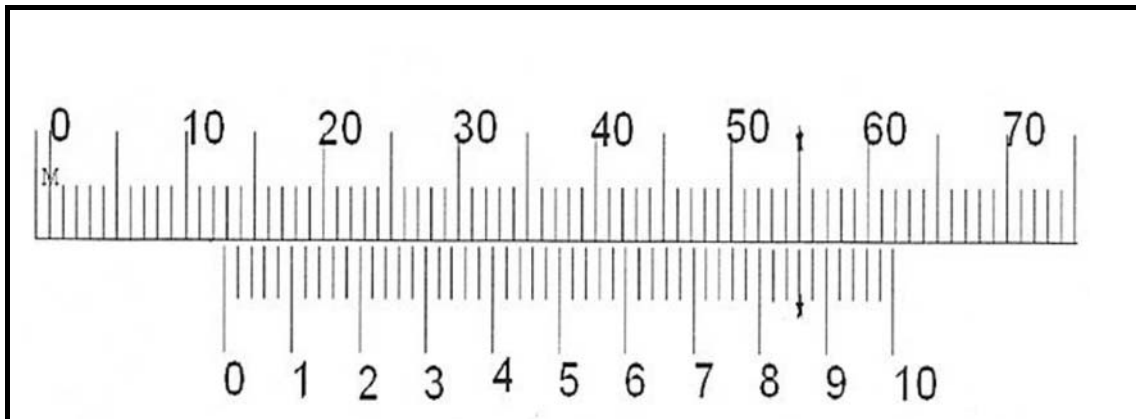	**[25]**

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

7.1   State ONE purpose of the following tools:

    7.1.1   Dial test indicator   (1)

    7.1.2   Tap wrench   (1)

7.2   Study FIGURE 7.2 below.

FIGURE 7.2

    7.2.1   From which engineering tool is the above reading taken?   (1)

    7.2.2   State TWO advantages of using the above tool instead of a
            micrometre.   (2)

7.3   Explain how you will cut an external thread on a shaft with a round die.   (3)
                                          [8]
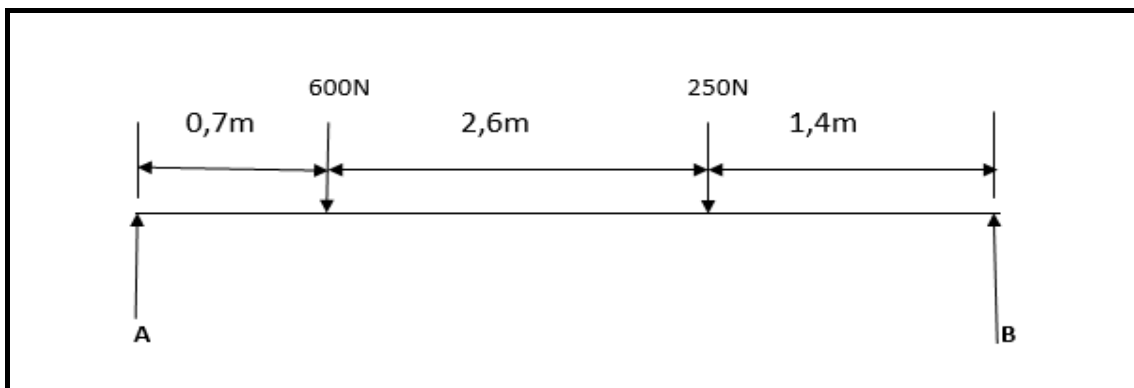
QUESTION 8: FORCES (SPECIFIC)

8.1 Answer the following questions with regards to basic mechanic's calculations:

8.1.1 Torque (1)

8.1.2 Moment of force (1)

8.1.3 Components of a force (1)

8.2 Study the beam below and answer the question that follows.

FIGURE 8.2

Calculate the magnitude of the reactions in supports A and B. (4)

8.3 Calculate the compressive stress in a 65 x 65 x 3 mm square steel tube that is subjected to a load of 25 kN. Give your answer in MEGA magnitude. (5)

8.4 FIGURE 8.4 below shows a system of forces with three coplanar forces acting on the same point.
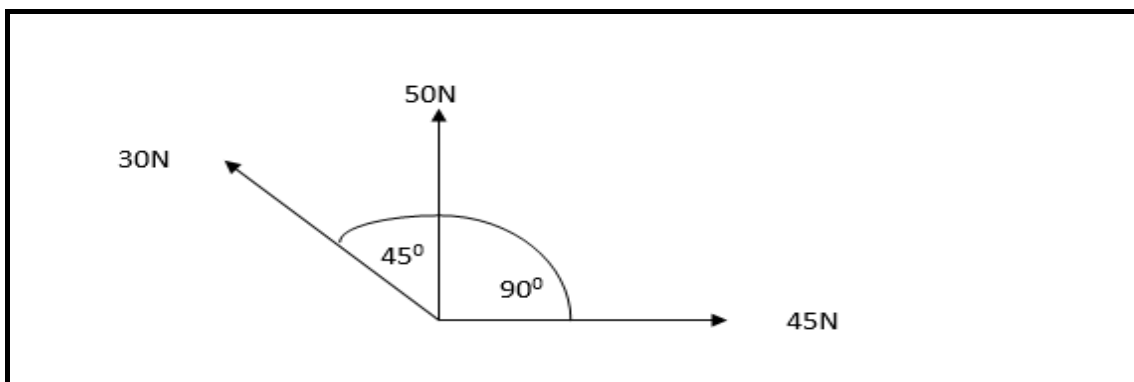
FIGURE 8.4

Use calculations and determine the magnitude and direction of the resultant force of this system of forces. (7)

[19]

## QUESTION 9: MAINTENANCE (SPECIFIC)

9.1   Explain the following terms used when studying causes of malfunctioning in machines:

     9.1.1   Viscosity   (2)

     9.1.2   Static balancing   (2)

     9.1.3   Coefficient of friction   (2)

9.2   Calculate the cutting speed of a specific material that is being machined, using an end milling cutter outside diameter 16 mm. The rotational speed(N) of the cutter is 320 revolutions per minute. The unit of measurement for cutting speed is m/min.   (2)

                                                     [8]

QUESTION 10: JOINING METHODS (SPECIFIC)

10.1   The length of a parallel key is 102 mm. Calculate:

     10.1.1   The diameter of the shaft   (3)

     10.1.2   The width of the key   (2)

     10.1.3   The thickness of the key   (2)

10.2   Why would a multi-start thread be preferred to a single start thread in some instances?   (2)

10.3   State THREE basic industrial applications of screw threads.   (3)

                                                     [12]

QUESTION 11: SYSTEMS AND CONTROL (SPECIFIC)

11.1   What is the function of an air receiver?   (2)

11.2   A force of 200 N acts on the small piston of a hydraulic press. The piston moves 100 mm. Calculate the force (F) exerted by the large piston if the area of the small piston is 0,1 m² and the area of the large piston is 1,5 m².   (4)

11.3   The gear system in FIGURE 11.3 below is used to control a hoisting device. The driver gear has 56 teeth and rotates at 700 r/min. The idler gear used to change the direction, rotates at 980 r/min. The driven gear has 64 teeth.
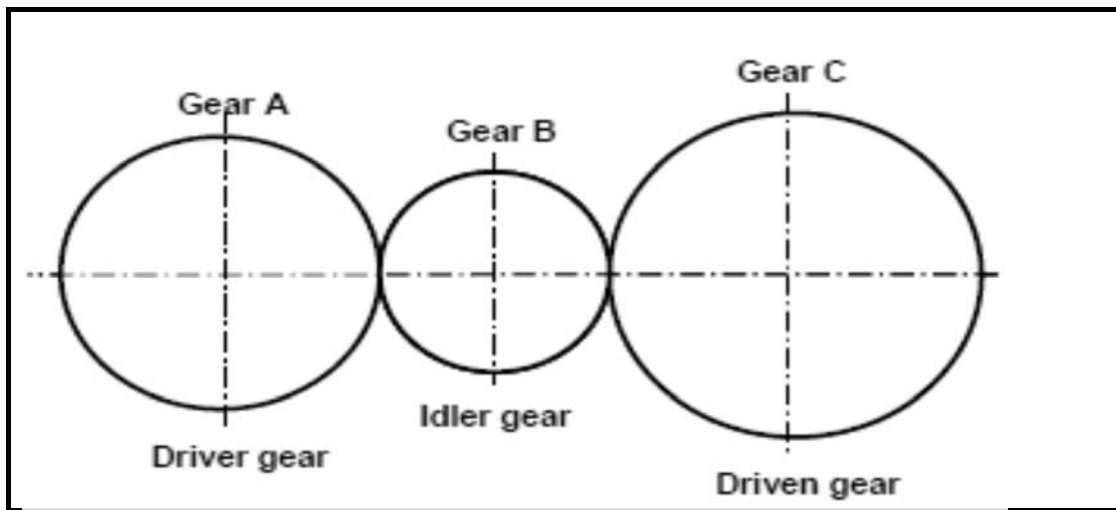
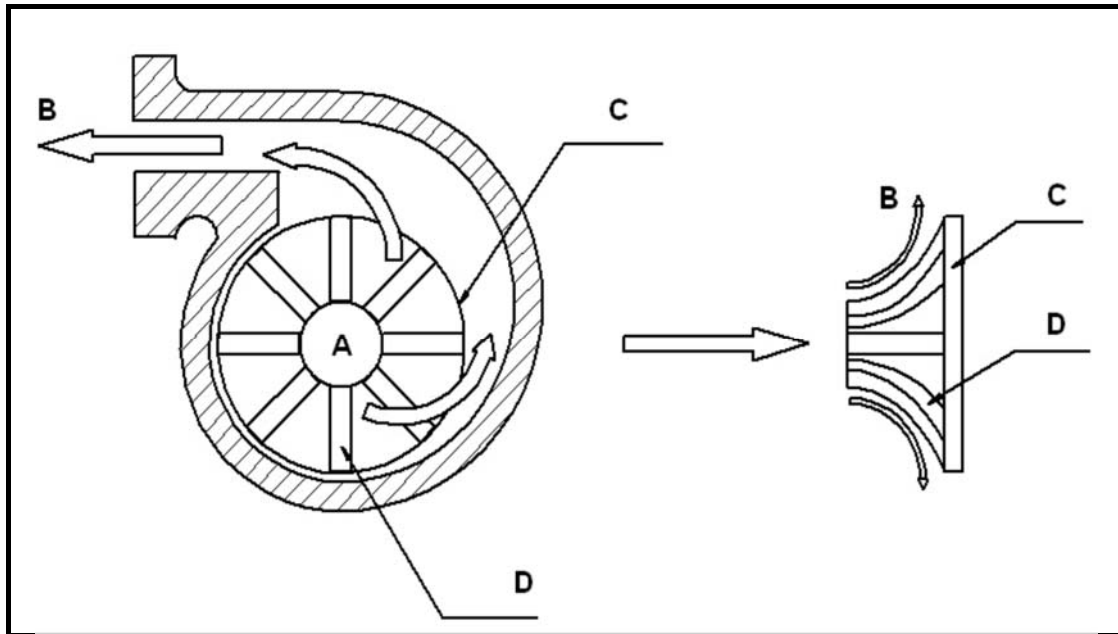**FIGURE 11.3**

Calculate the following:

11.3.1   The number of teeth on the idler gear   (3)

11.3.2   The rotational frequency of the driven gear   (2)

11.3.3   In which direction will the driven gear rotate if the driver gear rotates anti-clockwise?   (1)

11.4   Explain what you understand by the term *block and tackle*.   (2)

11.5   Name TWO pressures that can act on a fluid.   (2)

[16]

QUESTION 12: PUMPS (SPECIFIC)

12.1   State the purpose of the volute casing used in pumps.   (2)

12.2   List TWO applications of pumps.   (2)

12.3   FIGURE 12.3 shows a type of pump which can be used.

FIGURE 12.3

    12.3.1   Identify the type of pump shown in FIGURE 12.3.   (1)

    12.3.2   Label parts **A–D**.   (4)

    12.3.3   Explain the operation of the pump in FIGURE 12.3   (3)
                                                                              [12]

TOTAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY
(FITTING AND TURNING)

1. **BELT DRIVES**

   1.1 $N_1 D_1 = N_2 D_2$ where N = rotational frequency

   D = diameter of pulley

   1.2 $Beltspeed = \dfrac{\pi DN}{60}$

   1.3 $Speed ratio = \dfrac{Diameter\ of\ driven\ pulley}{Diameter\ of\ driver\ pulley}$

   1.4 $Power(P) = \dfrac{(T_1 - T_2)\pi\,DN}{60}$ OR $Power(P) = (T_1 - T_2)v$

2. **STRESS AND STRAIN**

   2.1 $Stress = \dfrac{Force}{Area}$ or $\sigma = \dfrac{F}{A}$

   2.2 $A_{shaft} = \dfrac{\pi d^2}{4}$

   2.3 $A_{pipe} = \dfrac{\pi(D^2 - d^2)}{4}$

   2.4 $A_{square\ bar} = length \times length$

3. **KEYS**

   3.1 $Width\ of\ key = \dfrac{Diameter\ of\ shaft}{4}$

   3.2 $Thickness\ of\ key = \dfrac{Diameter\ of\ shaft}{6}$

   3.3 $Length\ of\ key = 1{,}5 \times Diameter\ of\ shaft$

   3.4 $Standard\ taper\ for\ taper\ key: 1\ in\ 100\ or\ 1:100$

4.   GEAR DRIVES

4.1 $N_1T_1 = N_2T_2$ $where\ \ N = rotational\ frequency$

$T\ =\ number\ of\ teeth\ on\ the\ gear$

4.2 $Power\ (P) = \dfrac{2\pi NT}{60}$

4.3 $Gear\ ratio = \dfrac{\Pr oduct\ of\ the\ number\ of\ teeth\ on\ driver\ gears}{\Pr oduct\ of\ the\ number\ of\ teeth\ on\ driven\ gears}$

4.4 $\dfrac{N_{input}}{N_{output}} = \dfrac{\Pr oduct\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{\Pr oduct\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

4.5 $Belt\ speed\colon V = \pi DN$

5.   POWER

5.1 $IP = pLANn$

6.   SCREW THREAD

6.1 $Lead = number\ of\ starts \times pitch$

6.2 $Helix\ angle\colon tan\theta = \dfrac{lead}{\pi\ diameter}$

6.3 $Leading\ tool\ angle = 90° - (clearance\ angle + helix\ angle)$

6.4 $Following\ tool\ angle = 90° + (helix\ angle - clearance\ angle)$

6.5 $Depth\ of\ thread : H = 0{,}866\,P$

6.6 $Pitch\ diameter\ of\ thread : = OD - 2 \times \left[\dfrac{3 \times H}{8}\right]$

7.   TAPER TURNING

7.1 $Compound\ slide\ angle(tan\dfrac{\theta}{2} = \dfrac{D-d}{2l})$

8.   HYDRAULICS

8.1 $A_{piston} = \dfrac{\pi d^2}{4}$

8.2 $\Pr essure = \dfrac{Force}{Area}\ \ or\ \ p = \dfrac{F}{A}$

8.3   Vol = Cross-sectional Area x Stroke length