



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2015

MECHANICAL TECHNOLOGY

MARKS: 200

TIME: 3 hours



This question paper consists of 18 pages, including a formula sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the spaces provided on the answer book.
2. Answer ALL the questions.
3. Read all the questions thoroughly.
4. Number the questions carefully according to the numbering system used in this question paper.
5. Write neatly and legibly.
6. Show ALL calculations and units. Round off final answers to TWO decimal places.
7. Candidates are allowed to use non-programmable, scientific calculators and drawing/mathematical instruments.
8. Begin each question on a NEW page.
9. Use the criteria below to assist you in managing your time:

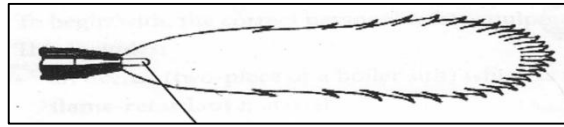
QUESTION	TOPIC	MARKS
1	Multiple-choice questions	20
2	Safety	10
3	Tools and equipment	12
4	Materials	13
5	Terminology	30
6	Joining methods	25
7	Forces	30
8	Maintenance	15
9	Systems and control	25
10	Pumps	20
	TOTAL:	200

- 1.6 Hardness refers to the material's ability to ...
- A resist penetration.
 - B be permanently shaped.
 - C stretch.
 - D absorb forces. (1)
- 1.7 Which taper-turning method is applicable on the centre lathe?
- A The tailstock can be offset for longer external tapers.
 - B The taper-turning attachment can be used for external tapers and for short internal boring.
 - C The compound slide rest can be rotated for turning short internal and external tapers.
 - D All of the above. (1)
- 1.8 Calculate the indexing for a gear with 38 teeth. Choose the correct answer.
- A 2 turns and 2 holes in a 38 hole circle
 - B 1 turn and 2 holes in a 38 hole circle
 - C 1 turn and 13 holes in a 49 hole circle
 - D 2 turns and 1 hole in a 49 hole circle (1)
- 1.9 Identify the component below that is supplementary to a milling machine.

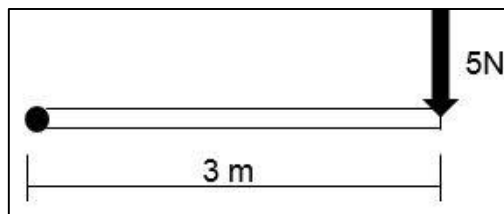


- A Arbour
 - B Saddle
 - C Compound slide
 - D Dividing head (1)
- 1.10 Which of the following statements defines the term 'purge' during gas welding?
- A To release fumes from the equipment
 - B To flush out gas before igniting the welding torch
 - C To mix the oxygen and acetylene
 - D To compress the fuel in the shank (1)

- 1.11 Given a sketch of a welding flame as shown below, select the correct procedure to achieve a suitable welding or brazing flame.



- A Adjust the oxygen until both first and second flame cones touch the third flame cone.
 B Adjust the oxygen until the tip of the second flame cone touches the tip of the first flame.
 C Adjust the oxygen until the tip of the first flame cone touches the third flame cone.
 D Adjust the oxygen until the second flame cone touches the third flame cone. (1)
- 1.12 Which of the following constitutes the equilibrium of three forces?
 A Two forces acting on a body
 B The calculation of forces
 C The concept of triangle of forces
 D The reaction on the supports (1)
- 1.13 Calculate the moment as shown in the figure below.



- Choose the correct answer:
 A 8 Nm
 B 18 Nm
 C 15 Nm
 D 10 Nm (1)
- 1.14 Complete the following: The lack of lubrication or incorrect lubrication ...
 A speeds up the motion of a rolling object.
 B increases engine speed.
 C ensures that operating systems malfunction.
 D converts motion from one form to another. (1)
- 1.15 Which of the following should be checked, before balancing a wheel?
 A The wheel rim must be examined for damaged edges.
 B The suspension should be firm.
 C The kingpin should be tilted back.
 D The pivot angle radius should be 90° . (1)

- 1.16 Which of the following statements is an advantage of the single helical gear as shown below?

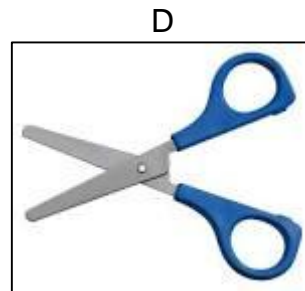


- A The gears are expensive.
B The contact between the meshing teeth takes place very gradually.
C Friction due to the sliding motion between the meshing teeth is high.
D It must run in an oil-bath. (1)
- 1.17 When will you be able to make use of a worm and worm gear drive?



- A When parts must be adjusted with reference to one another.
B When the direction of the drive must change through 90° and the centre lines of the drive shafts are situated on the same plane.
C When the drive is very rough.
D When the rotary movement is changed to reciprocating motion. (1)

1.18 Which of the following is an example of a third class lever?



(1)

1.19 Which of the following pumps is used mainly to pump sandy, muddy or sewerage water with ease?

- A Rotor pump
- B Reciprocating pump
- C Centrifugal pump
- D Vane pump

(1)

1.20 Which of the following is an advantage of a Vane pump in its operation?

- A The drive is always positive.
- B They are very efficient for slow-speed engines.
- C It has no valves or springs.
- D It has no moving valves.

(1)

[20]

QUESTION 2: SAFETY

2.1 State whether the following statements are TRUE or FALSE.

- 2.1.1 Use a machine ONLY once the safety guards have been correctly fitted. (1)
- 2.1.2 Never clean or adjust a machine whilst it is in motion. (1)
- 2.1.3 Leave the chuck key in the chuck when you are NOT at the lathe. (1)
- 2.1.4 A drill should run at a high speed when drilling a 30 mm hole. (1)

- 2.2 Name any FOUR safety rules to be taken into account before working with a bench grinder.



FIGURE 2.2

(4)

- 2.3 Mention TWO safety precautions to be taken when starting or stopping machinery.

(2)

[10]

QUESTION 3: TOOLS AND EQUIPMENT

- 3.1 Name THREE important usages when operating the tap wrench.



(3)

- 3.2 Which lubricant would you use when cutting a thread on bronze, copper or steel?

(1)

- 3.3 What is the function of a pitch gauge?

(1)

- 3.4 Describe how you would care for a power saw.

(2)

- 3.5 What is the function of the inverter (DC) welding machine?

(1)

- 3.6 Give TWO reasons for using the torque wrench.

(2)

- 3.7 What is the function of a power-driven shearing machine?

(1)

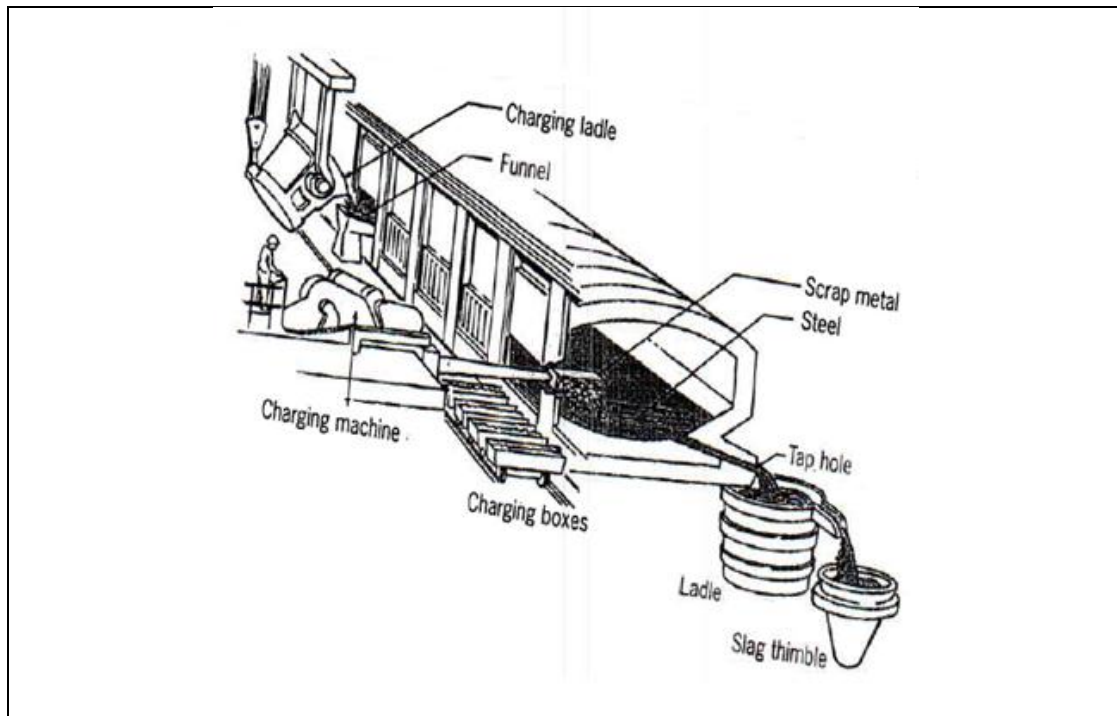
- 3.8 How would you care for manual and electric guillotines?

(1)

[12]

QUESTION 4: MATERIALS

4.1 Identify the steel-making furnace in the FIGURE below. (1)



4.2 Define the properties of the following:

- 4.2.1 Elasticity (2)
- 4.2.2 Ductility (2)
- 4.2.3 Brittleness (2)
- 4.2.4 Malleability (2)
- 4.2.5 Plasticity (1)

4.3 Identify THREE of the several quenching media that are used to give different rates of cooling. (3)
[13]

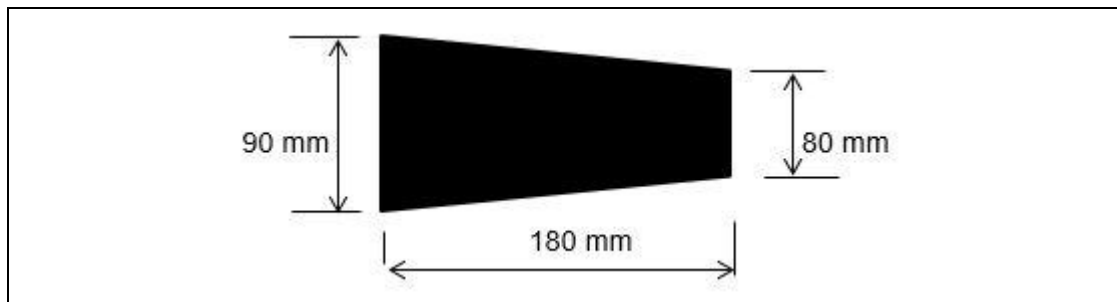
QUESTION 5: TERMINOLOGY

- 5.1 Use a milling machine to cut a hexagon on a 100 mm shaft. Calculate the depth of the cut. (6)
- 5.2 Explain the cutting procedure to cut a taper on the centre lathe, using the compound slide parallel with the lathe bed. (10)



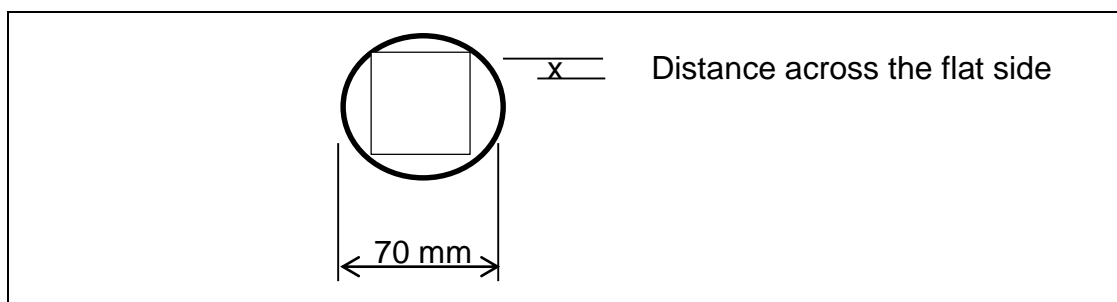
(10)

- 5.3 A taper 180 mm long, has to be turned on the end of a 90 mm diameter shaft. If the diameter of the small end of the taper is 80 mm, calculate the angle to which the compound slide must be set in order to cut this taper. (6)



(6)

- 5.4 A shaft with a diameter of 70 mm must be machined on a milling machine to a square. Calculate the distance across the flat side that must be cut away. (6)



(6)

- 5.5 Calculate the index to cut a pentagon using simple indexing. (2)

[30]

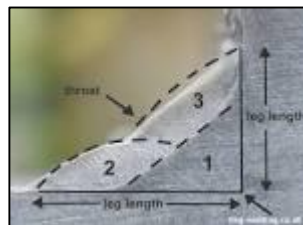
QUESTION 6: JOINING METHODS

- 6.1 What do you understand by permanent joining applications? (1)
- 6.2 Explain step-by-step the application of soft solder. (4)
- 6.3 What joining application is being performed in the illustrations below? (1)

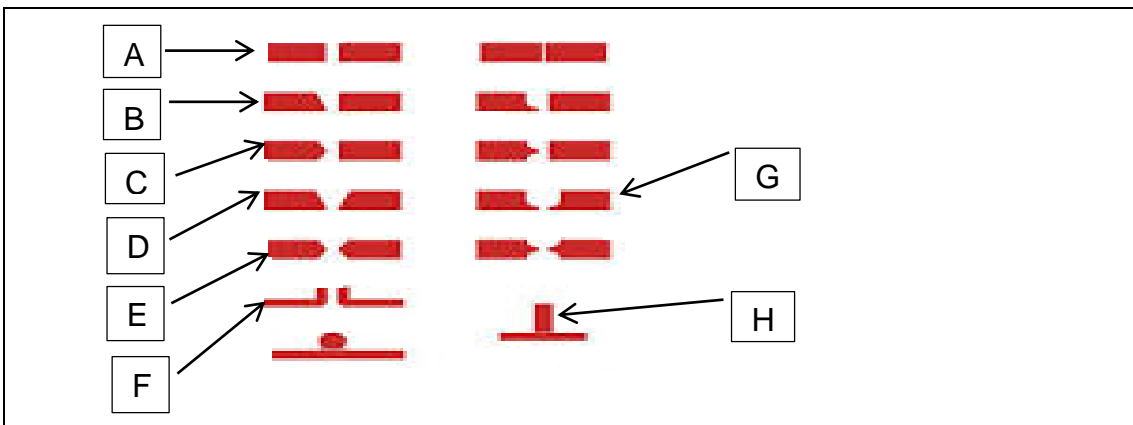


FIGURE 6.3

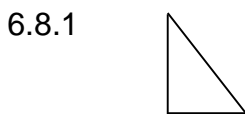
- 6.4 How does the number of welds on a welding joint influence the parent metal? (2)



- 6.5 How does the size of the weld influence the welding joint? (2)
- 6.6 Identify the welding joints as shown in the illustrations below. (8)



- 6.7 Identify the remaining FOUR primary factors that influence a welding joint, excluding the number of welds and size of welds. (4)
- 6.8 Identify the following welding symbols in the illustrations below. (3)



[25]

QUESTION 7: FORCES

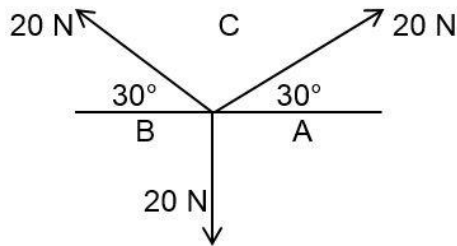
7.1 Define the following basic concepts of systems of forces:

7.1.1 Equilibrant (2)

7.1.2 Bow's notation/Triangle of forces (2)

7.1.3 Components of a force (2)

7.2 The following system of forces contains three forces. Use Bow's notation to construct a triangle of forces and show how they are in equilibrium.

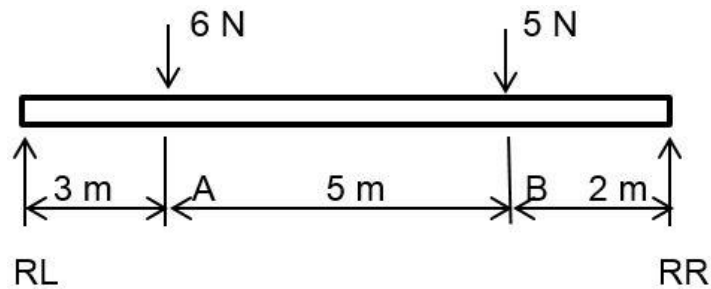


7.2.1 Draw the space diagrams using the scale 4 cm = 10 N. (3)

7.2.2 Draw the vector diagram using the scale 4 cm = 10 N. (3)

7.2.3 Why do you think the triangle of forces is in equilibrium? (1)

7.3 A beam is subjected to two point loads and one UDL, and is supported at each end by RL and RR.

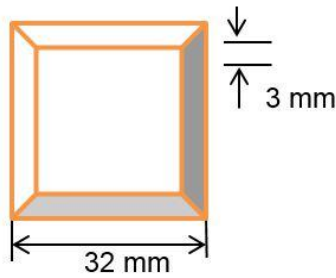


7.3.1 Calculate the magnitude of RR and RL. (4)

7.3.2 Calculate the bending moments at points A and B. (4)

7.3.3 Test the beam for equilibrium. (1)

7.4 Calculate the compressive stress in a 32 x 32 x 3 mm square tube if it is subjected to a load of 70 kN.



(5)

7.5 A 220 N force is inclined at 30° to the horizontal.

7.5.1 Draw the diagram and indicate the two components (X and Y) of the force that need to be calculated.

(1)

7.5.2 Determine (by calculation) the horizontal and vertical components of the force.

(2)

[30]

QUESTION 8: MAINTENANCE

8.1 Inadequate maintenance affects operating systems. Explain how inadequate maintenance will affect the following:

8.1.1 Balancing of wheels

(4)

8.1.2 Overloading of machines

(2)

8.2 Define positive camber with regard to wheel alignment.

(2)

8.3 Briefly explain kingpin inclination.



(2)

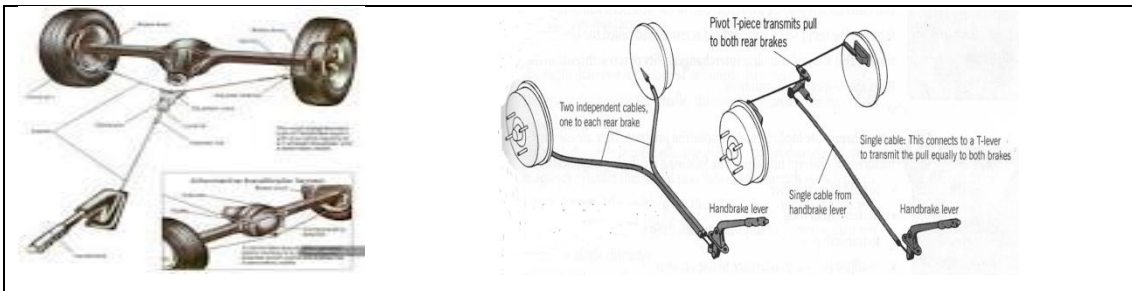
8.4 Make a sketch showing the Ackerman principle (toe-out on turns), indicating the different steering angles and relevant components on the drawing.

(5)

[15]

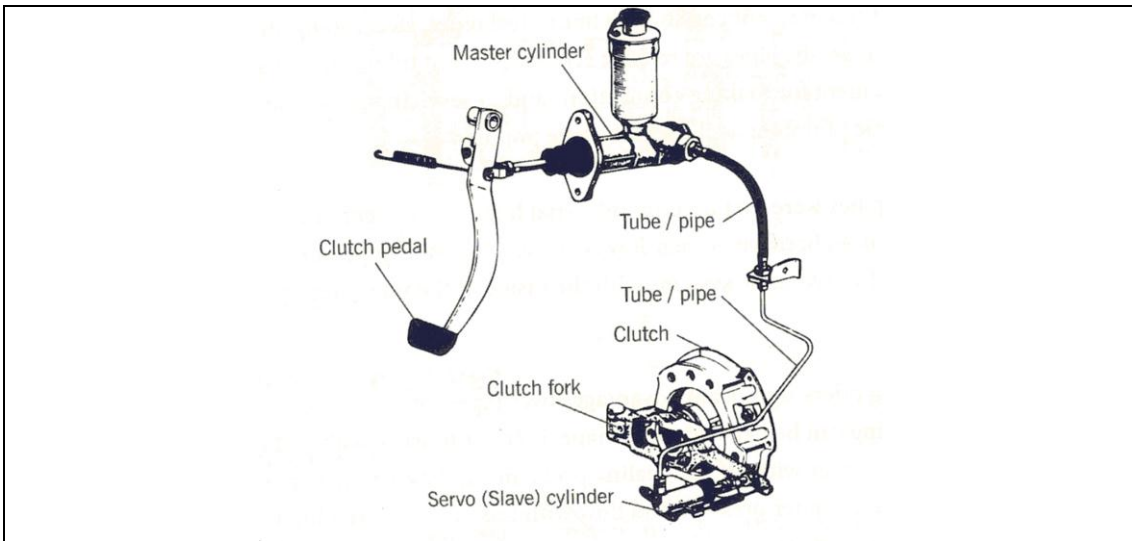
QUESTION 9: SYSTEMS AND CONTROL

9.1 With the aid of the illustrations below, explain the operating principle of the handbrake on a motor vehicle.



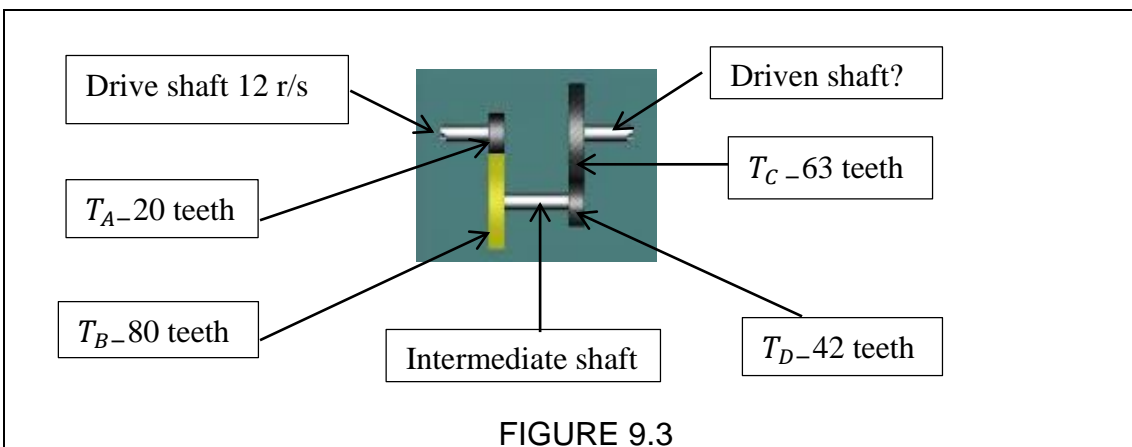
(3)

9.2 Explain the basic operating principles of the hydraulic clutch in a motor vehicle.



(6)

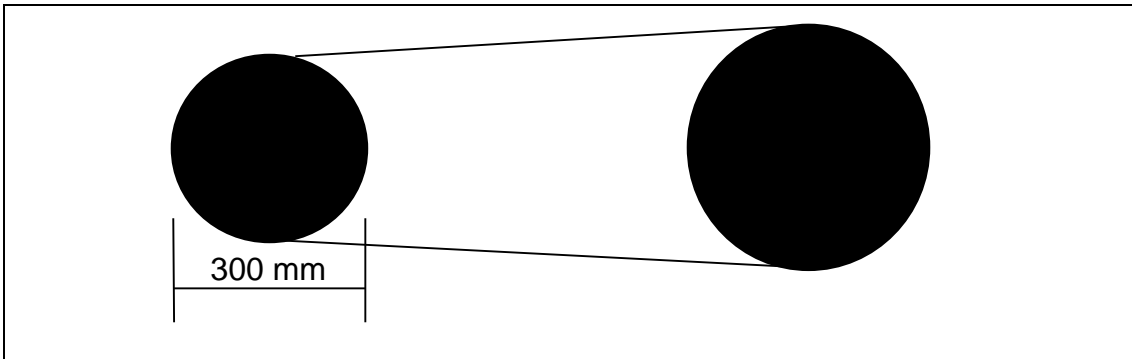
9.3 Calculate the rotational frequency (speed) of the driven shaft in FIGURE 9.3.



(5)

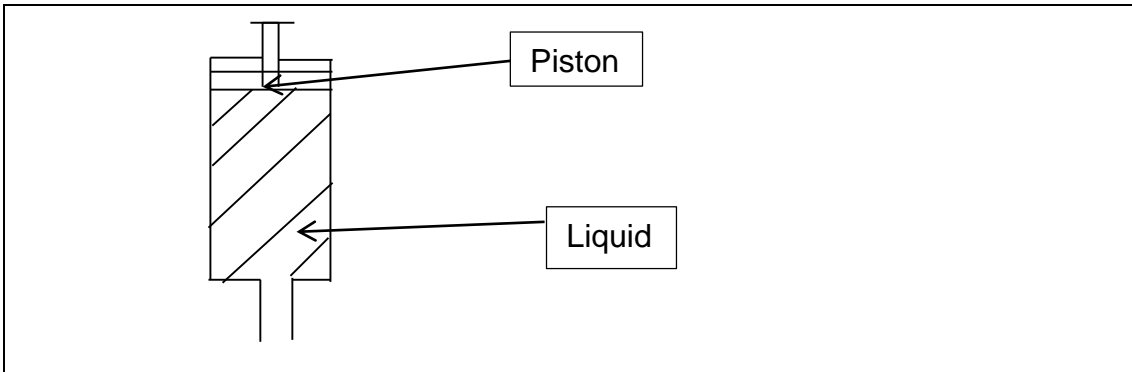
9.4 A driving pulley with an effective diameter of 300 mm rotates at 950 rpm. The tension at the tight side of the belt is 600 N and the ratio of tensions is 2:1.

Calculate the power transmitted.



(6)

9.5 A piston acts on liquid with a force of 7 500 N and the area of the piston is 3 m². Find the pressure in the liquid.



(3)

9.6 Describe the use of a piston in hydraulics/pneumatics systems.

(2)
[25]

QUESTION 10: PUMPS

10.1 FIGURE 10.1 below shows a gear-type pump. Label the parts A–E.

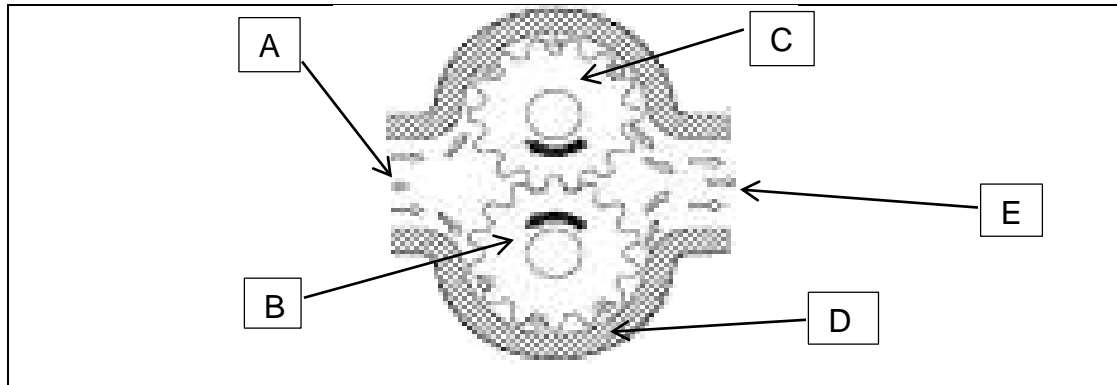
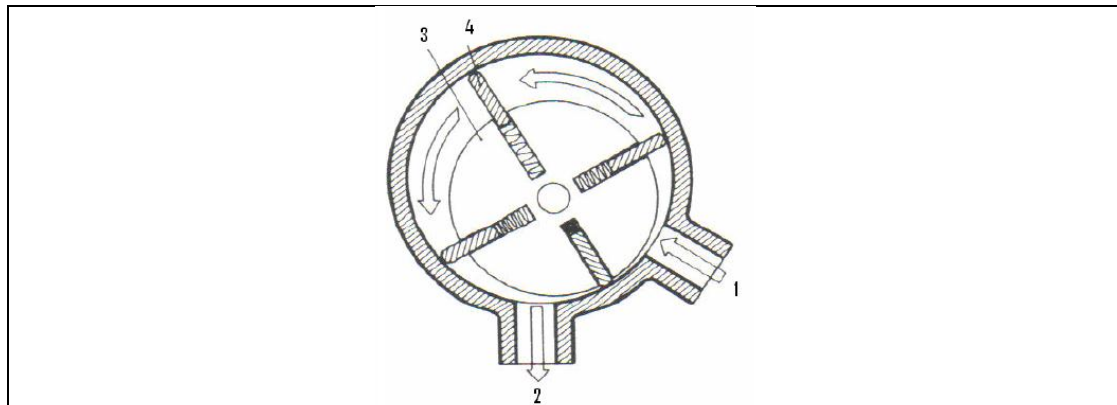


FIGURE 10.1

(5)

10.2 Describe the operating principle of a vane pump.



(6)

10.3 Identify TWO specific uses of the mono pump.

(2)

10.4 Identify TWO typical areas where you will use a mono pump.

(2)

10.5 Explain the operating principles of a centrifugal pump.



(5)

TOTAL: [20] 200

GRADE 11

FORMULA SHEET

1. GAUGE BLOCKS
Set nr. M.50

Range	increment in mm	number of blocks
1,0025 to 1,0075	0,0025	3
1,01 to 1,09	0,01	9
1,1 to 1,9	0,1	9
1 to 25	1,0	25
50; 75; 100		3
0,5		1

2. FRICTION:

F = force of friction

μ = co-efficient of friction

N = Normal force

$$F = \mu \times N$$

3. TORQUE: T

T = Force x Distance were

T = N.m.

4. BELT DRIVES

4.1	Belt speed = $\frac{\pi DN}{60}$
4.2	Belt speed = $\frac{\pi(D+t)N}{60}$ (t = belt thickness)
4.3	Belt mass/kilogram = Area × length × density (A = thickness × width)
4.4	Speed ratio = $\frac{\text{Dia.of driven pulley}}{\text{Dia.of driver pulley}}$
4.5	Output speed = $\frac{\text{drive pulley}}{\text{driven pulley}} \times \frac{\text{drive pulley}}{\text{driven pulley}} \times \text{input speed}$
4.6	Open-belt length = $\frac{\pi(D+d)}{2} + \frac{(D-d)^2}{4c} + 2c$
4.7	Crossed-belt length = $\frac{\pi(D+d)}{2} + \frac{(D+d)^2}{4c} + 2c$
4.8	Power (P) = $\frac{2\pi NT}{60}$
4.9	Ratio of tight side to slack side = $\frac{T_1}{T_2}$
4.10	Power (P) = $\frac{(T_1 - T_2)\pi DN}{60}$
4.11	Width = $\frac{T_1}{\text{Permissible tensile force}}$
4.12	Dia _A × N _A = Dia _B × N _B

5. GEAR DRIVES: SPUR GEAR

5.1	Power (P) = $\frac{2\pi NT}{60}$
5.2	Gear ratio = $\frac{\text{product of driven gears teeth}}{\text{product of drive gears teeth}}$
5.3	$\frac{N_{in}}{N_{out}} = \frac{\text{product of driven gears teeth}}{\text{product of drive gears teeth}}$
5.4	Torque = force \times radius
5.5	Torque transmitted = gear ratio \times input torque
5.6	$T_A \times N_A = T_B \times N_B$

6. HYDRAULICS

6.1	Pressure = $\frac{\text{Force (F)}}{\text{Area (A)}}$
6.2	Volume = cross-sectional area \times stroke length (l or s)
6.3	Work done = force \times distance

7. Forces

7.1	Stress = $\frac{\text{Force}}{\text{Area}}$
7.2	Strain = $\frac{\text{Change in Length}}{\text{Original Length}}$

8. Indexing

8.1	Crank T = $\frac{40}{N}$
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9. Taper Turning

9.1	Tan $\Theta = \frac{D-d}{2 \times L}$
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10. Depth of hexagon cut = $\frac{\text{Diameter of shaft} - \text{distance across flat side}}{2}$