basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY

FEBRUARY/MARCH 2012

MARKS: 200

TIME: 3 hours

This question paper consists of 19 pages, a 5-page formula sheet and 1 answer sheet.

* M C H T D M *

INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the spaces provided on the ANSWER BOOK and the ANSWER SHEET.
2. Read ALL the questions carefully.
3. Answer ALL the questions.
4. Answer the questions in QUESTION 1 on the attached ANSWER SHEET. Place the completed ANSWER SHEET in the ANSWER BOOK.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Start EACH question on a NEW page.
7. Show ALL calculations and units. Round off final answers to TWO decimal places.
8. Candidates may use non-programmable scientific calculators and drawing instruments.
9. The value of the gravitational force constant should be taken as 10 m/s^2.
10. All dimensions are in millimetres, unless stated otherwise in the question.
11. Write neatly and legibly.
12. Use the criteria below to assist you in managing your time.

QUESTION	ASSESSMENT STANDARDS	CONTENT	MARKS	TIME
1	1–9	Multiple-choice Questions	20	18 minutes
2	2	Tools and Equipment	20	18 minutes
3	3	Materials	20	18 minutes
4	1, 4 and 5	Safety, Terminology and Joining Methods	50	45 minutes
5	7 and 9	Maintenance and Turbines	40	36 minutes
6	6 and 8	Forces, Systems and Control	50	45 minutes
		TOTAL	**200**	**180 minutes**

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and make a cross (X) in the block (A–D) next to the question number (1.1–1.20) on the attached ANSWER SHEET.

EXAMPLE:

1.21	A	B	C	D

1.1 Which ONE of the following safety measures applies to a milling machine?

A The material to be sawn must be clamped securely in the vice.
B Always remove the key from the chuck.
C Never reach over or near the rotating cutter.
D Make sure that the blades are tightened properly. (1)

1.2 Which ONE of the following safety procedures relates to a moments-and-forces tester?

A Remove primary coil lead to prevent sparks from occurring.
B When coolant is contaminated, it must be changed.
C Make sure that the blades are tightened properly.
D Make sure that the object to be tested is firmly secured. (1)

1.3 What is the function of a torsion tester?

A It measures the resistance of a material to a static force.
B It measures the flow of exhaust gases.
C It measures the twisting action in a member caused by two opposing moments along the longitudinal axis of the member.
D It measures the current flowing in a circuit. (1)

1.4 Shielding the arc and molten pool from atmospheric gases is the function of the …

A inert gas.
B outlet gas.
C inlet gas.
D air-fuel mixture. (1)

1.5 What is the purpose of using flux when soft-soldering as shown in FIGURE 1.1?

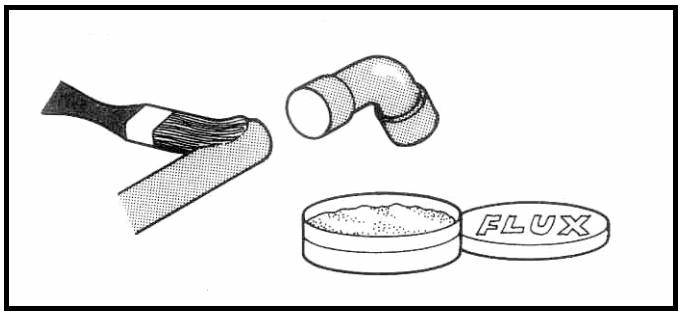


FIGURE 1.1

A Ensures that there are no weld craters
B Ensures that the heated surface is smooth
C Ensures that the soldered joint is tough
D Ensures chemical cleanliness of the heated surface (1)

1.6 What are *thermoplastic materials*?

A Materials that can be stretched and return to their original shape
B Materials that soften under heat and become hard when cooled
C Materials that cannot be reshaped by heating
D Materials that form a rigid shape under pressure (1)

1.7 FIGURE 1.2 shows an operation to machine a work piece. Identify tool A shown in the figure.

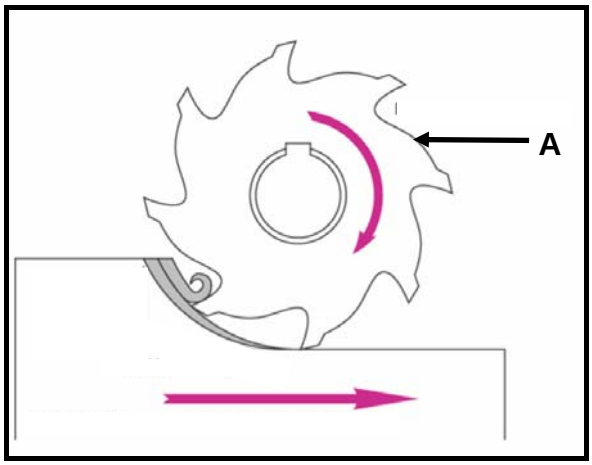


FIGURE 1.2

A End mill
B Work piece
C Milling cutter
D Circular saw (1)

1.8 Which lathe operation is shown in FIGURE 1.3?

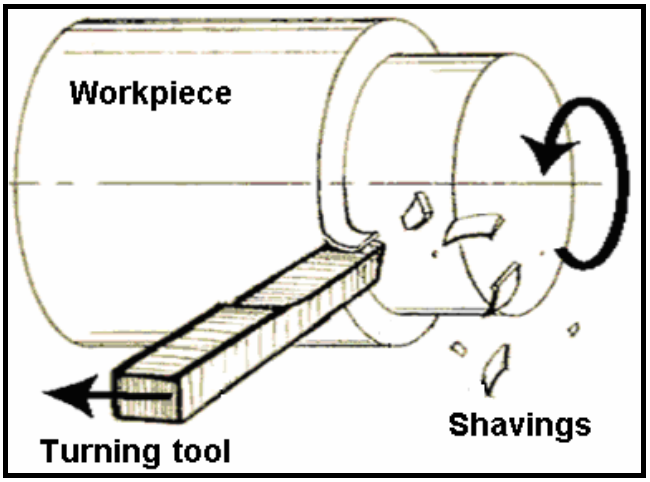


FIGURE 1.3

A Parallel cutting
B Drilling
C Boring
D Thread cutting (1)

1.9 Which ONE of the following is an advantage of down-cut milling?

A The finish obtained is finer.
B Coarse feed may be used.
C Vibration experienced is less.
D The strain on the cutter and arbor is less. (1)

1.10 What type of test is shown in FIGURE 1.4?

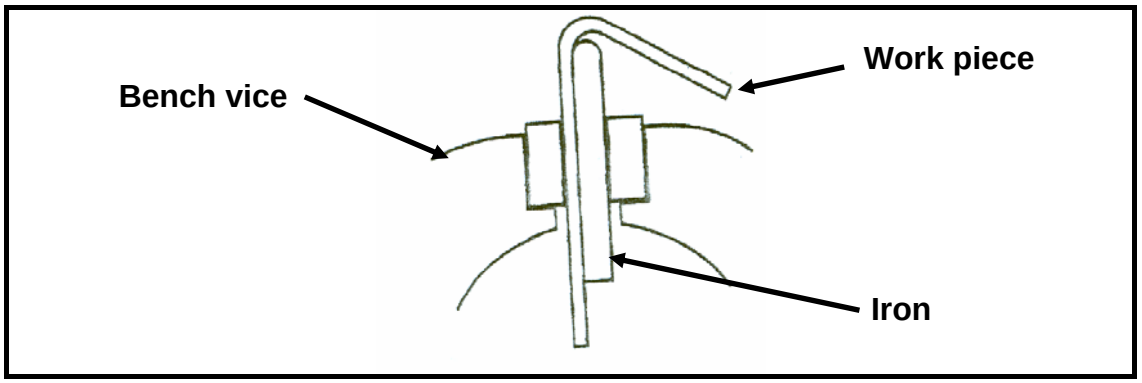


FIGURE 1.4

A Simple guide bend test
B Free bend test
C 180° guided bend test
D 180° close bend test (1)

1.11 In a tensile test …

A a test piece is loaded to destruction.
B beams are used to determine the structure of a weld.
C a hammer is used to break the test material.
D liquid dye is used to detect weld flaws. (1)

1.12 The stress-strain curve for low-carbon steel is shown in FIGURE 1.5. What does point A in the figure denote?

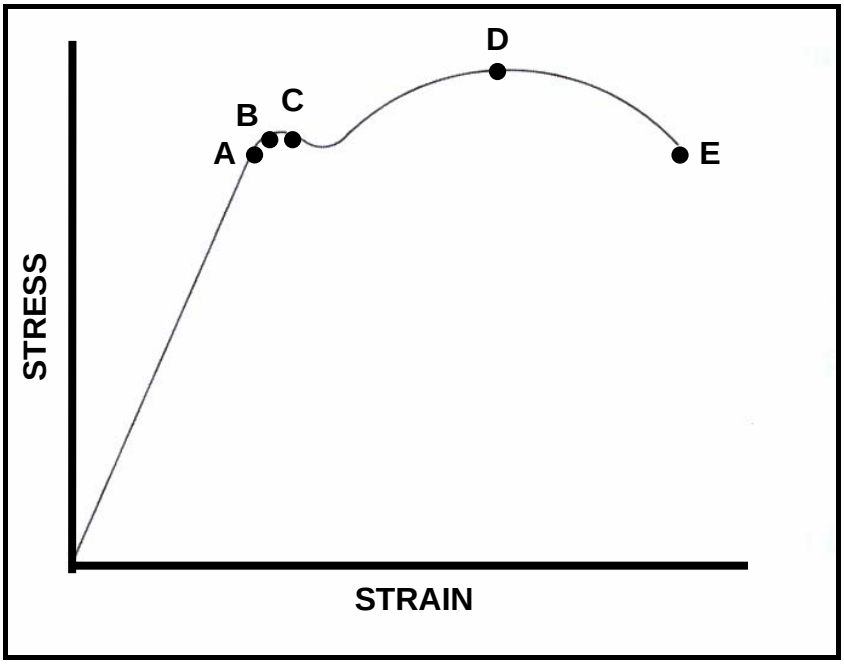


FIGURE 1.5

A Lower yield point
B Maximum stress
C Upper yield point
D Limit of proportionality (1)

1.13 What is understood by the term *stress*?

A Ratio of the force to the cross-sectional area
B Ratio of increase in length to the original length
C Ratio of stress to the applied force
D Ratio of force to the original length (1)

1.14 Which ONE of the following is a function of a friction clutch?

A It supports light radial loads.
B It transmits power at high speeds.
C It supports high-pressure loads.
D It carries a combination of radial and axial thrust loads. (1)

1.15 Which ONE of the following is an advantage of a chain-and-sprocket transmission system?

A Low in cost
B Needs no lubrication
C Smooth operation
D Slip-free drive (1)

1.16 FIGURE 1.7 shows three gears meshing. What is gear B called?

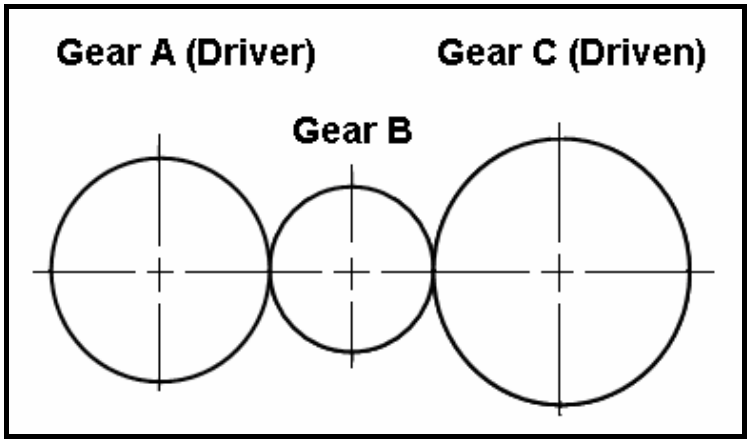


FIGURE 1.7

A Helical gear
B Rack
C Idler gear
D Pinion (1)

1.17 What class of lever does FIGURE 1.8 illustrate?

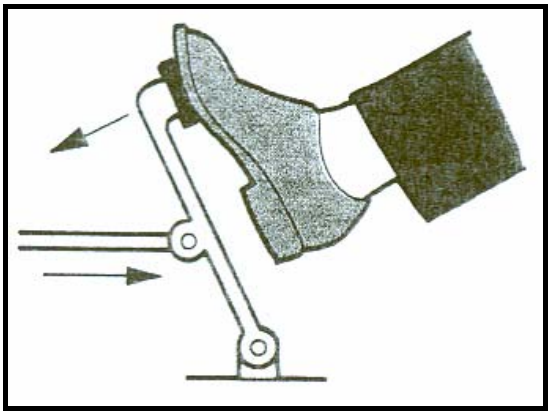


FIGURE 1.8

A First
B Second
C Third
D Fourth (1)

1.18 Identify the mechanism shown in FIGURE 1.9.

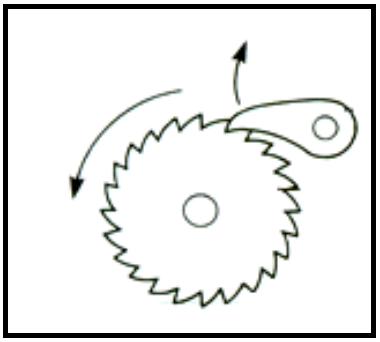


FIGURE 1.9

A Ratchet and pawl
B Worm and worm wheel
C Wheel and pinion
D Driver and driven (1)

1.19 What is the function of the waste gate in a turbo charger?

A Releases excess pressure
B Releases excess moisture
C Releases excess heat
D Releases excess oil (1)

1.20 What will the volumetric efficiency be if a 100 mm^3 blower displaces 79 mm^3 per revolution?

A 100%
B 79%
C 21%
D 179% (1)

[20]

QUESTION 2: TOOLS AND EQUIPMENT

2.1 Mr Zungu had conducted a cylinder-leakage test and obtained certain results. State ONE possible result and the fault on the cylinder. (2)

2.2 A gas analyser is an important piece of equipment as it is used to analyse the exhaust gases of an internal combustion engine. Give TWO reasons for a high CO reading. (2)

2.3 State the purpose for the following tests done on metals:

2.3.1 Tensile test (2)

2.3.2 Beam-bending test (2)

2.4 Name TWO types of hardness testers. (2)

2.5 Name THREE functions of a multimeter. (3)

2.6 FIGURE 2.1 shows a sketch of the MAGS welding nozzle during the welding process. Label the parts according to the letters A–G.

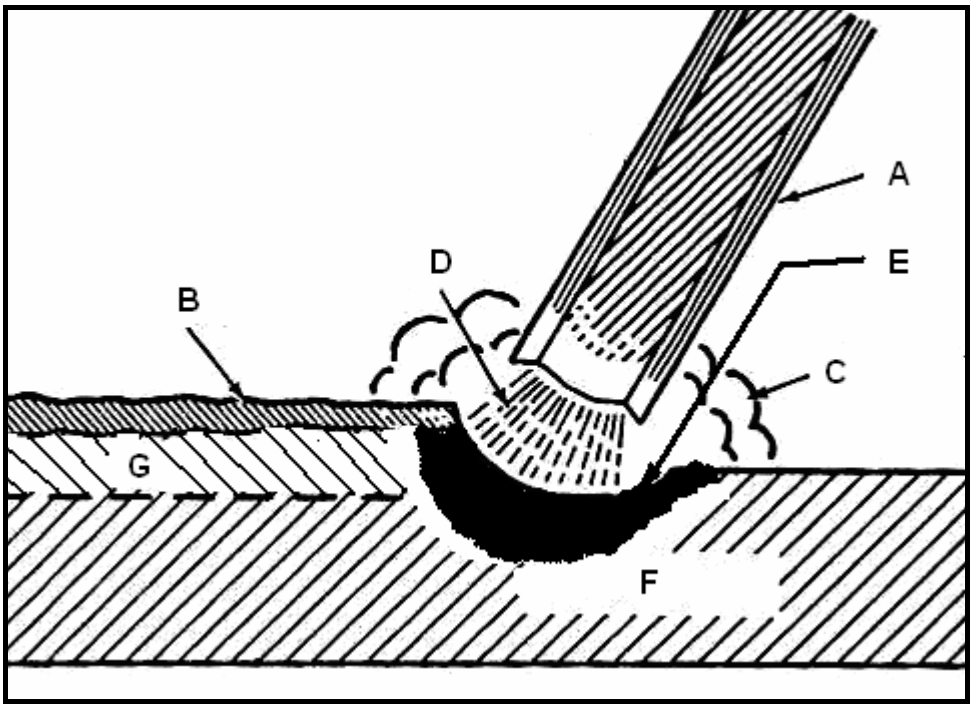


FIGURE 2.1 (7)

[20]

QUESTION 3: MATERIALS

3.1 Name TWO main elements of ferrous alloys. (2)

3.2 Two different materials A and B are shown in FIGURE 3.1. Both are subjected to the same force that causes torsional stress in the material.

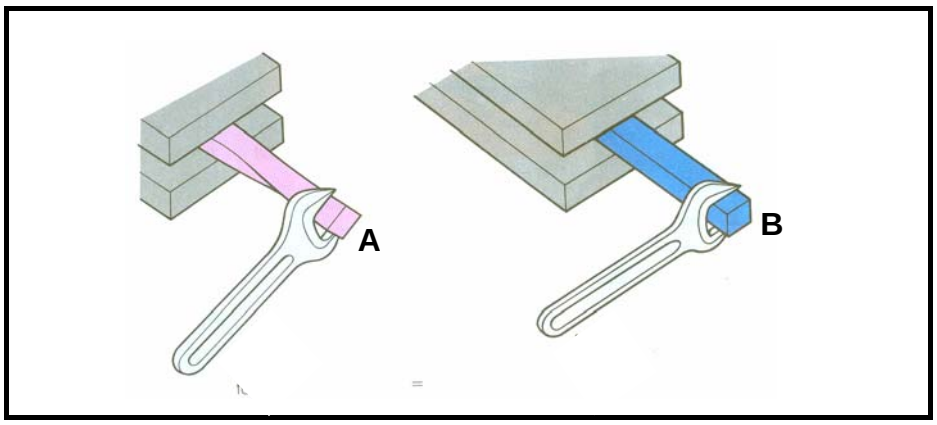


FIGURE 3.1

3.2.1 Identify the material with the highest resistance against torsion. (1)

3.2.2 Give a reason for your answer to QUESTION 3.2.1. (2)

3.3 Development in engineering materials and their applications have led to numerous innovative breakthroughs in the manufacturing industry, one such material is a non-ferrous alloy.

3.3.1 What do you understand by a *non-ferrous alloy*? (2)

3.3.2 Name THREE examples of non-ferrous alloys. (3)

3.4 FIGURE 3.2 shows a cross-sectional view of a tap for use on a wash basin. The tap casing is made of a non-ferrous alloy.

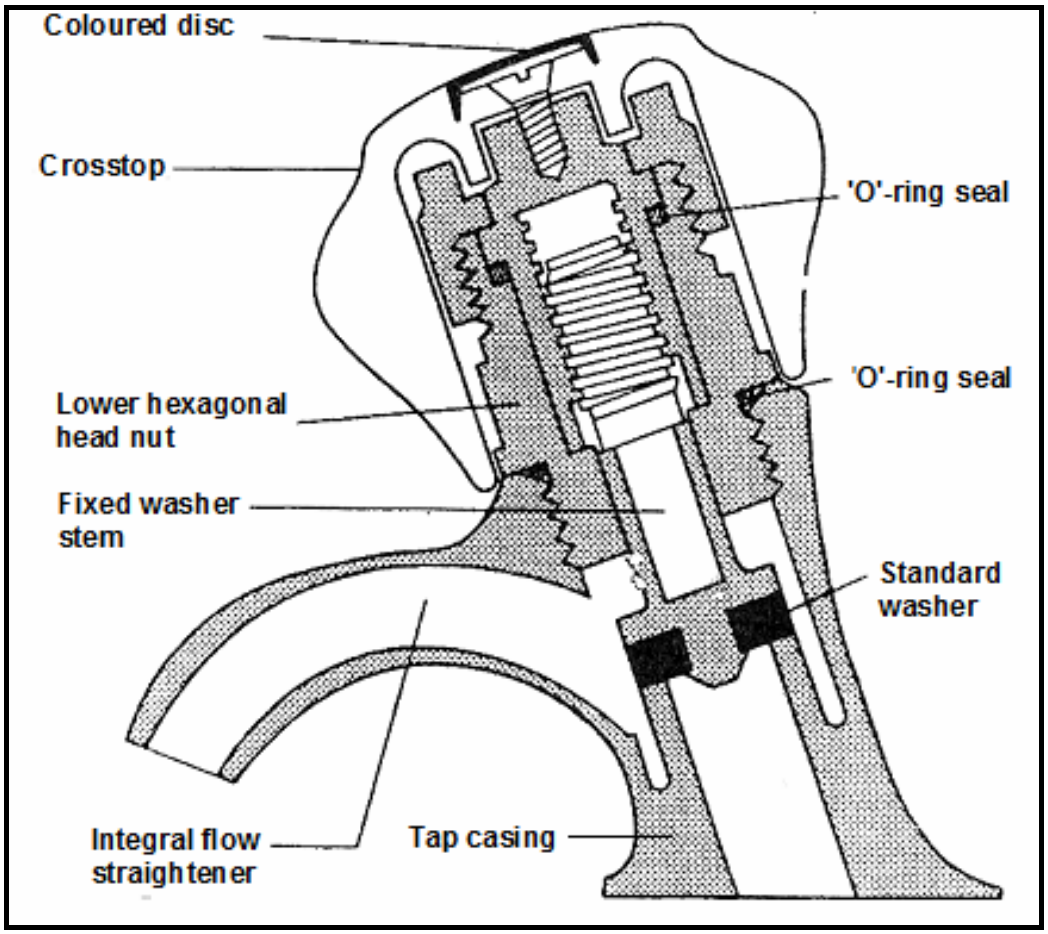


FIGURE 3.2

3.4.1 Identify the non-ferrous alloy that would be suitable for manufacturing the tap casing. (2)

3.4.2 Identify the material suitable for the fixed washer stem. (1)

3.4.3 Identify the material suitable for the hand piece/crosstop. (1)

3.4.4 Name FOUR common properties of the metals used in the manufacture of the water-tap casing. (4)

3.4.5 What is the function of the 'O'-ring seals? (2)
[20]

QUESTION 4: SAFETY, TERMINOLOGY AND JOINING METHODS

4.1 FIGURE 4.1 shows a milling machine. Label the parts according to the letters A–F.

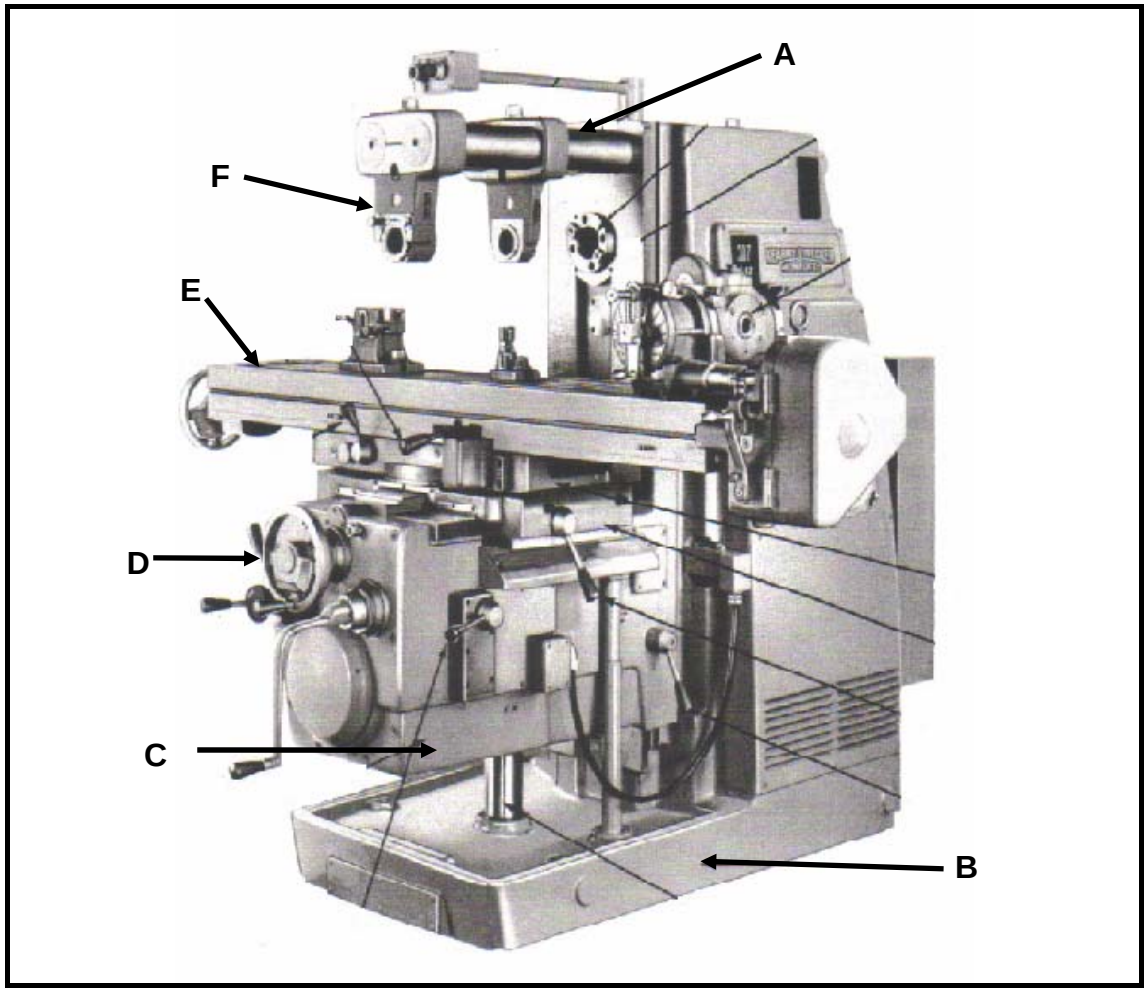


FIGURE 4.1 (6)

4.2 Describe the method used to counteract the side thrust of the helical cutter when milling takes place. (2)

4.3 Calculate the table feed in millimetres per minute of a 140 mm diameter cutter with 46 teeth, operating at a cutting speed of 120 metres per minute and a feed of 0,1 mm per tooth. (6)

4.4 State the indexing method used for the following:

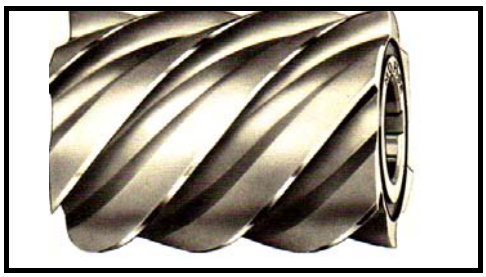
4.4.1 The worm and worm wheel are disconnected (1)

4.4.2 The number of divisions cannot be divided by 40 and there is no hole circle available to accommodate the number of divisions (1)

4.4.3 Cutting a hexagon on a shaft (1)

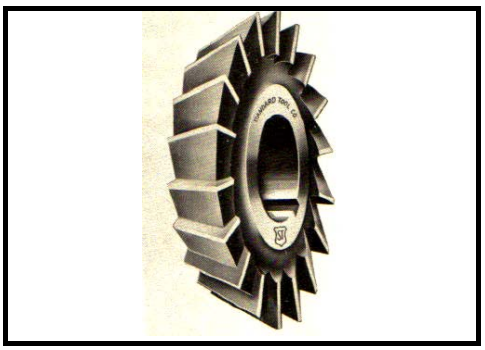
4.5 Identify the milling cutters shown in FIGURE 4.2:

4.5.1



(1)

4.5.2

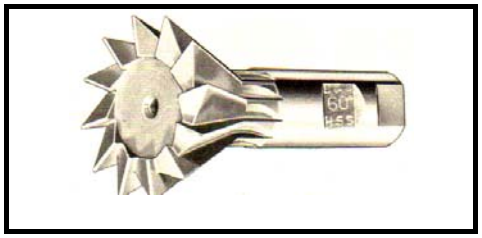


(1)

4.5.3

(1)

4.5.4



(1)

FIGURE 4.2

4.6 Two gears that mesh with each other need to be manufactured. The one gear should have 56 teeth with a PCD of 126 mm, while the other gear should have 39 teeth with a PCD of 87,75 mm.

Determine, by means of calculations, the following:

4.6.1 The module of the small gear (2)

4.6.2 The module of the large gear (2)

4.6.3 The outside diameter of the large gear (3)

4.6.4 The dedendum of the large gear (2)

4.6.5 The clearance of the large gear (2)

4.6.6 The indexing needed to cut the large gear (3)

4.7 Name THREE types of non-destructive tests that can be performed on welded joints. (3)

4.8 Name TWO possible causes for the following weld defects:

4.8.1 Insufficient penetration (2)

4.8.2 Porosity (2)

4.8.3 Welding craters (2)

4.9 Name TWO safety measures to be observed when using the Brinell hardness tester. (2)

4.10 Name FOUR safety precautions to be observed when using a bearing and gear puller. (4)
[50]

QUESTION 5: MAINTENANCE AND TURBINES

5.1 Oil filters are used to clean the engine oil so as to prolong the lifespan of an engine. Explain in point form how you will remove and fit a new oil filter to an engine when servicing a motor vehicle. (5)

5.2 Give THREE reasons why engine oil must be changed. (3)

5.3 How would you be able to identify an automatic transmission fluid? (2)

5.4 Bearings play a very important role for the smooth running of components.

5.4.1 Name THREE loads a bearing is subjected to. (3)

5.4.2 Name THREE causes of bearings overheating. (3)

5.4.3 Give TWO reasons for the grease lubrication of a wheel bearing. (4)

5.5 A large number of vehicles make use of turbochargers to enhance their performance. FIGURE 5.1 shows a turbocharger arrangement.

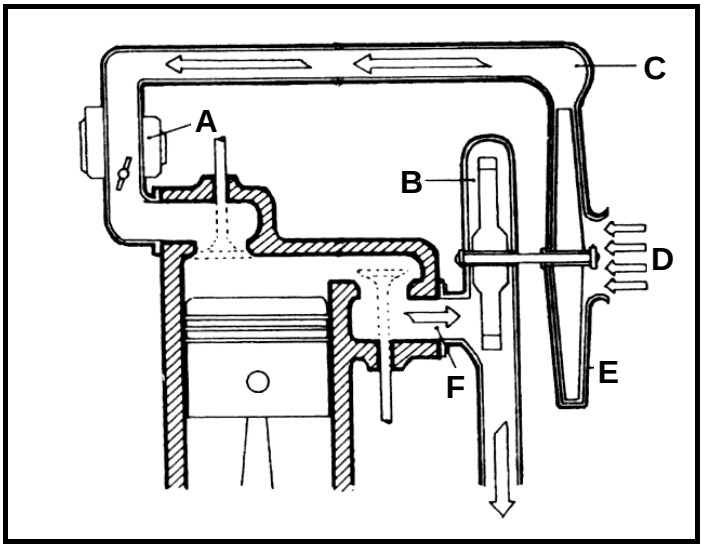


FIGURE 5.1

5.5.1 Label the parts according to the letters A–F. (6)

5.5.2 Explain the operation of the turbocharger. (6)

5.5.3 Why is a turbocharged engine fitted with an oil cooler? (2)

5.6 Give FOUR advantages of a gas turbine as used in a jet plane. (4)

5.7 State TWO methods that can be employed to drive a supercharger. (2)

[40]

QUESTION 6: FORCES, SYSTEMS AND CONTROL

6.1 A hydraulic system is being used to move machine parts during the assembling process. The specifications of the system are diagrammatically presented in FIGURE 6.1.

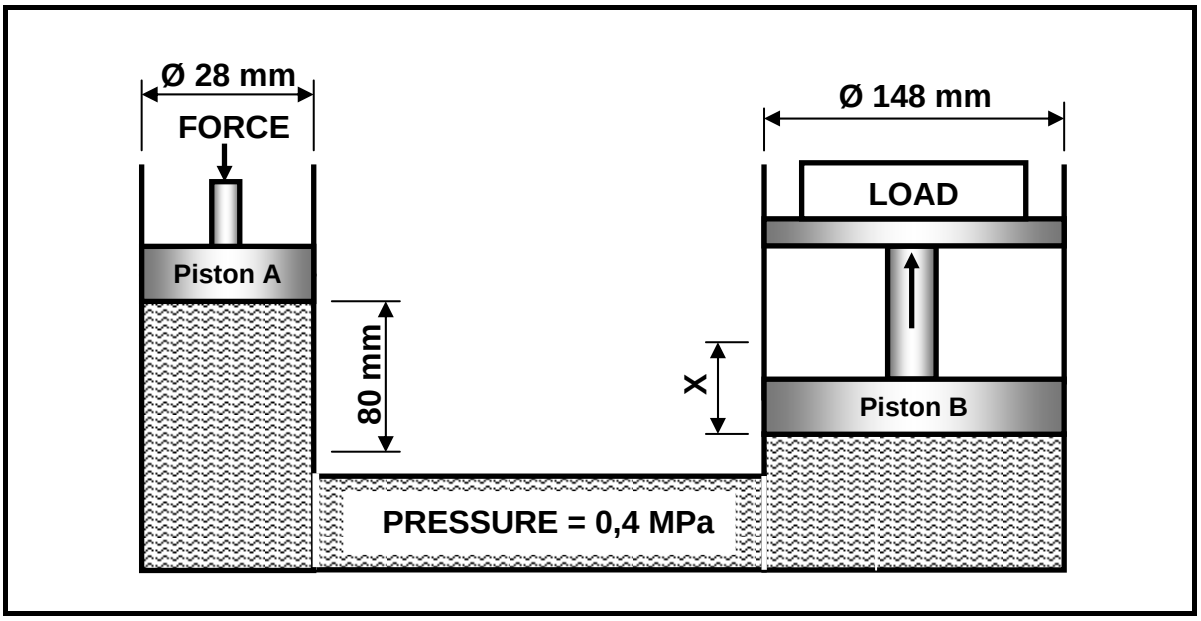


FIGURE 6.1

Determine, by means of calculations, the following:

6.1.1 The force applied to piston A (5)

6.1.2 The distance X, in millimetres, that piston B will move with 10 strokes of piston A (7)

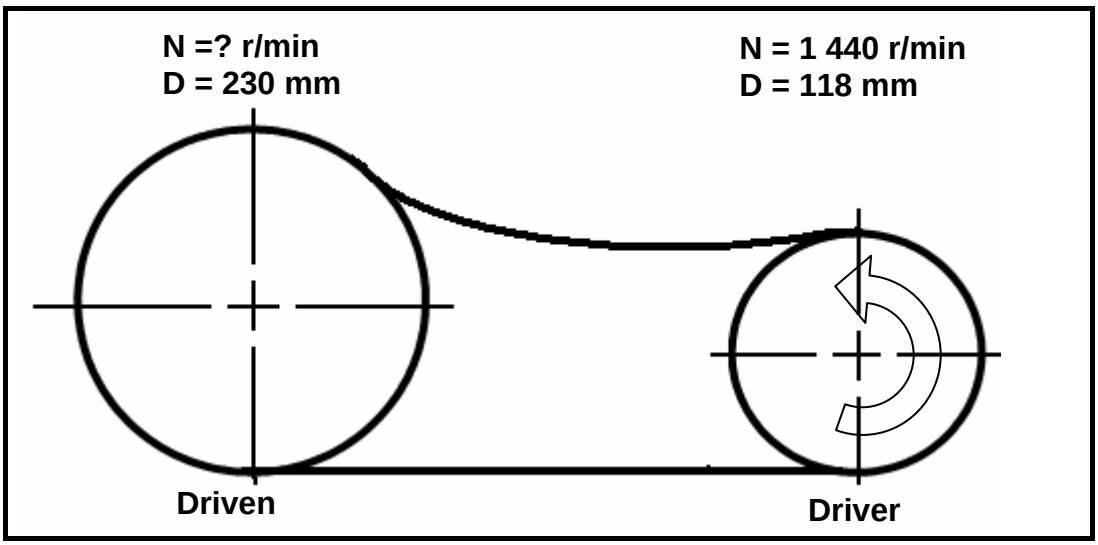
6.2 A load of 12 kN causes a tensile stress of 24,5 MPa in a brass round bar. The original length of the bar is 250 mm and Young's modulus for brass is 90 GPa.

Determine, by means of calculations, the following:

6.2.1 The diameter, in millimetres, of the brass bar (6)

6.2.2 The change in length, in millimetres, caused by the load (6)

6.3 The belt-drive system of a water pump is shown in FIGURE 6.2. The driver pulley on the electrical motor has a diameter of 118 mm and rotates at 1 440 r/min while the driven pulley has a diameter of 230 mm.



FIGUUR 6.2

Determine, by means of calculations, the following:

6.3.1 The rotation frequency of the driven pulley in r/min (3)

6.3.2 The belt speed of the system in metres per second (3)

6.3.3 The power transmitted in this system if the ratio of the tensile force in the tight side to the tensile force in the slack side is 2,5 : 1. The tensile force in the tight side is 300 N. (5)

6.4 A differential wheel-and-axle lifting machine shown in FIGURE 6.3 has a mechanical advantage of 4. A load of 1,6 kN is lifted when an effort is applied. The diameters of the pulleys are 280 mm, 200 mm and 120 mm respectively.

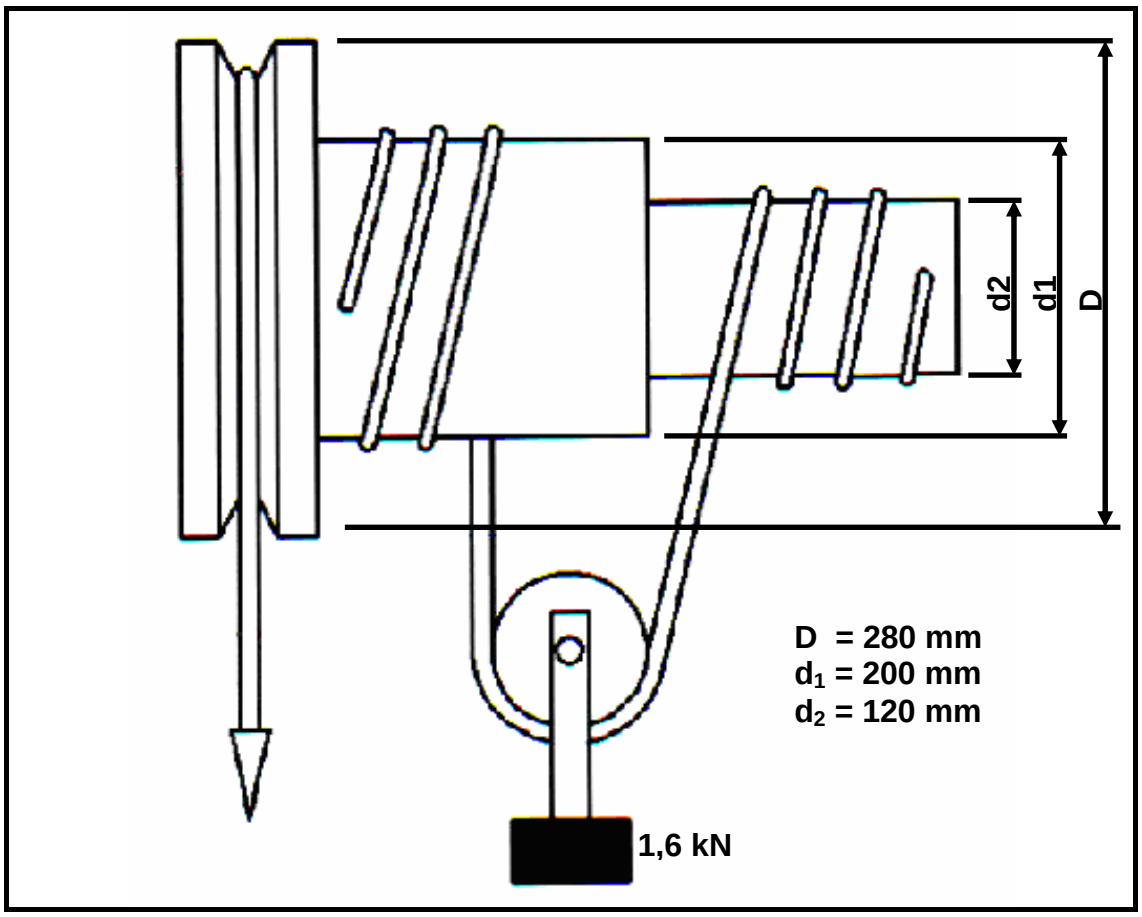


FIGURE 6.3

Determine, by means of calculations, the following:

6.4.1 The effort applied (3)

6.4.2 The velocity ratio (3)

6.4.3 The mechanical efficiency (3)

6.5 A single-plate friction clutch is used to transmit power from the engine to the gearbox main shaft. The plate has an effective diameter of 180 mm. The clutch plate has friction material on both sides with a friction co-efficient of 0,45. The total applied force on the pressure plate is 3,5 kN.

Determine, by means of calculations, the following:

6.5.1 The maximum torque that can be transmitted (3)

6.5.2 The power transmitted at 4 500 r/min in kW (3)
[50]

TOTAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY – GRADE 12

1. BELT DRIVES

1.1 $Belt\ speed = \frac{\pi DN}{60}$

1.2 $Belt\ speed = \frac{\pi\,(D + t) \times N}{60}$ $(t = belt\ thickness)$

1.3 $Belt\ mass = Area \times length \times density$ $(A = thickness \times width)$

1.4 $Speed\ ratio = \frac{Diameter\ of\ driven\ pulley}{Diameter\ of\ driver\ pulley}$

1.5 $N_1 D_1 = N_2 D_2$

1.6 $Open\text{-}belt\ length\ = \frac{\pi(D + d)}{2} + \frac{(D - d)^2}{4c} + 2c$

1.7 $Crossed\text{-}belt\ length = \frac{\pi(D + d)}{2} + \frac{(D + d)^2}{4c} + 2c$

1.8 $Power\ (P) = \frac{2\pi NT}{60}$

1.9 $Ratio\ of\ tight\ side\ to\ slack\ side = \frac{T_1}{T_2}$

1.10 $Power\ = \frac{(T_1 - T_2)\,\pi\,DN}{60}$

Where: $T_1 = force\ in\ the\ tight\ side$

1.11 $Width\ = \frac{T_1}{Permissible\ tensile\ force}$

2. FRICTION CLUTCHES

2.1 $Torque\,(T) = \mu WnR$

Where : $\mu = coefficient\ of\ friction$
$W = total\ force$
$n = number\ of\ friction\ surfaces$
$R = effective\ \ radius$

2.2 $Power\ \ (P) = \dfrac{2\pi NT}{60}$

3. STRESS AND STRAIN

3.1 $Stress = \dfrac{Force}{Area} \quad or \quad (\sigma = \dfrac{F}{A})$

3.2 $\text{Strain } (\varepsilon) = \dfrac{\text{change in length } (\Delta L)}{\text{original length } (L)}$

3.3 $Young's\ modulus\ (E) = \dfrac{stress}{strain} \quad or \quad (\dfrac{\sigma}{\varepsilon})$

3.4 $A_{shaft} = \dfrac{\pi d^2}{4}$

3.5 $A_{pipe} = \dfrac{\pi(D^2 - d^2)}{4}$

4. HYDRAULICS

4.1 $Pressure\ (P) = \dfrac{Force\ (F)}{Area\ (A)}$

4.2 $\dfrac{F_1}{A_1} = \dfrac{F_2}{A_2}$

4.3 $Volume = Cross\text{-}sectional\ area \times stroke\ length\ (l\ or\ s)$

4.4 $Work\ done = force \times distance$

5. WHEEL AND AXLE

5.1 $Velocity\ ratio\ (VR) = \frac{effort\ distance}{load\ distance} = \frac{2D}{d_1 - d_2}$

5.2 $Mechanical\ advantage\ (MA) = \frac{Load\ (W)}{Effort\ (F)}$

5.3 $\text{Mechanical efficiency } (\eta_{mech}) = \frac{\text{MA}}{\text{VR}} \times 100\%$

6. LEVERS

6.1 $Mechanical\ advantage\ (MA) = \frac{Load\ (W)}{Effort\ (F)}$

6.2 *Input movement (IM) = Effort × distance moved by effort*

6.3 *Output movement (OM) = Load × distance moved by load*

6.4 $Velocity\ ratio\ (VR) = \frac{Input\ movement}{Output\ movement}$

7. SCREW THREADS

7.1 *Pitch diameter = Outside diamter – ½pitch*

7.2 *Pitch circumference = π × pitch diameter*

7.3 *Lead = pitch × number of starts*

7.4 $Helix\ angle:\ \tan Ø = \frac{Lead}{Pitch\ circumference}$

7.5 *Leading tool angle = 90° – (helix angle + clearance angle)*

7.6 *Following/Trailing angle = 90° + (helix angle – clearance angle)*

7.7 $Number\ of\ turns = \frac{height}{lead}$

8. GEAR DRIVES

8.1 $Power\ (P) = \frac{2\pi NT}{60}$

8.2 $Gear\ ratio = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{Product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

8.3 $\frac{N_{input}}{N_{output}} = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{Product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

8.4 $Torque = force \times radius$

8.5 $Torque\ transmitted = gear\ ratio \times input\ torque$

8.6 $Module\ (m) = \frac{Pitch\text{-}circle\ diameter\ (PCD)}{Number\ of\ teeth\ (T)}$

8.7 $N_1T_1 = N_2T_2$

8.8 $Pitch\text{-}circle\ diameter\ (PCD) = \frac{circular\ pitch\ (CP) \times number\ of\ teeth\ (T)}{\pi}$

8.9 $Outside\ diameter\ (OD) = PCD + 2\ module$

8.10 $Addendum\ (a) = module\ (m)$

8.11 $Dedendum\ (b) = 1{,}157\ m$ *or* $Dedendum\ (b) = 1{,}25\ m$

8.12 $Cutting\ depth\ (h) = 2{,}157\ m$ *or* $Cutting\ depth\ (h) = 2{,}25\ m$

8.13 $Clearance\ (c) = 0{,}157\ m$ *or* $Clearance\ (c) = 0{,}25\ m$

8.14 $Circular\ pitch\ (CP) = m \times \pi$

9. CINCINNATI DIVIDING-HEAD TABLE FOR THE MILLING MACHINE

Hole circles											
Side 1	*24*	*25*	*28*	*30*	*34*	*37*	*38*	*39*	*41*	*42*	*43*
Side 2	*46*	*47*	*49*	*51*	*53*	*54*	*57*	*58*	*59*	*62*	*66*

Standard change gears										
24 x 2	*28*	*32*	*40*	*44*	*48*	*56*	*64*	*72*	*86*	*100*

9.1 $\text{Simple indexing} = \frac{40}{n}$ *(where n = number of divisions)*

9.2 *Change gears:*

$$\frac{Dr}{Dv} = (A - n) \times \frac{40}{A} \quad or \quad \frac{Dr}{Dv} = \frac{(A - n)}{A} \times \frac{40}{1} \quad or \quad \frac{Dr}{Dv} = (N - n) \times \frac{40}{N}$$

10. CALCULATIONS OF FEED

10.1 *Feed (f)* $= f_1 \times T \times N$

Where: *f = feed in millimetres per minute*

f_1 *= feed per tooth in millimetres*

T = number of teeth on cutter

N = number of revolutions of cutter per minute

10.2 *Cutting speed (V)* $= \pi \times D \times N$

Where: *D = diameter of the cutter in metres*

ANSWER SHEET

CENTRE NUMBER:													
EXAMINATION NUMBER:													

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D
1.16	A	B	C	D
1.17	A	B	C	D
1.18	A	B	C	D
1.19	A	B	C	D
1.20	A	B	C	D

[20]

ANTWOORDBLAD

SENTRUMNOMMER:													
EKSAMENNOMMER:													

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D
1.16	A	B	C	D
1.17	A	B	C	D
1.18	A	B	C	D
1.19	A	B	C	D
1.20	A	B	C	D

[20]

9. CINCINNATI-VERDEELKOPTABEL VIR DIE FREESMASJIEN

Gatsirkels											
Sy 1	*24*	*25*	*28*	*30*	*34*	*37*	*38*	*39*	*41*	*42*	*43*
Sy 2	*46*	*47*	*49*	*51*	*53*	*54*	*57*	*58*	*59*	*62*	*66*

Standaardwisselratte										
24 x 2	*28*	*32*	*40*	*44*	*48*	*56*	*64*	*72*	*86*	*100*

9.1 *Eenvoudige indeksering* $= \frac{40}{n}$ *(waar n = getal indelings)*

9.2 *Wisselratte:*

$$\frac{Dr}{Gd} = (A - n) \times \frac{40}{A} \quad of \quad \frac{Dr}{Gd} = \frac{(A - n)}{A} \times \frac{40}{1} \quad of \quad \frac{Dr}{Gd} = (N - n) \times \frac{40}{N}$$

10. BEREKENINGE BY TOEVOER

10.1 *Toevoer* $(f) = f_1 \times T \times N$

Waar: f = *toevoer in millimeter per minuut*

f_1 = *toevoer per tand in millimeter*

T = *getal tande van die snyer*

N = *getal omwentelinge per minuut van die snyer*

10.2 *Snyspoed* $(V) = \pi \times D \times N$

Waar: D = *diameter van die snyer in meter*

8. RATAANDRYWING

8.1 $$Drywing\ (P) = \frac{2\pi NT}{60}$$

8.2 $$Ratverhouding = \frac{Produk\ van\ die\ getal\ tande\ op\ gedrewe\ ratte}{Produk\ van\ die\ getal\ tande\ op\ dryfratte}$$

8.3 $$\frac{N_{inset}}{N_{uitset}} = \frac{Produk\ van\ \ die\ getal\ tande\ op\ die\ gedrewe\ ratte}{Produk\ van\ die\ getal\ tande\ op\ die\ dryfratte}$$

8.4 $$Wringkrag = krag \times radius$$

8.5 $$Wringkrag\ oorgedra = ratverhouding \times insetwringkrag$$

8.6 $$Module\ (m) = \frac{Steeksirkeldiameter\ (SSD)}{Getal\ tande\ (T)}$$

8.7 $$N_1T_1 = N_2T_2$$

8.8 $$Steeksirkeldiameter\ (SSD) = \frac{sirkelsteek\ (SS) \times getal\ tande\ (T)}{\pi}$$

8.9 $$Buitediameter\ (BD) = SSD + 2\ module$$

8.10 $$Addendum\ (a) = module\ (m)$$

8.11 $$Dedendum\ (b) = 1{,}157\ m \quad of \quad Dedendum\ (b) = 1{,}25\ m$$

8.12 $$Snydiepte\ (h) = 2{,}157\ m \quad of \quad Snydiepte\ (h) = 2{,}25\ m$$

8.13 $$Vry\ ruimte\ (c) = 0{,}157\ m \quad of \quad Vry\ ruimte\ (c) = 0{,}25\ m$$

8.14 $$Sirkelsteek\ (SS) = m \times \pi$$

5. WIEL EN AS

5.1 $$Snelheidsverhouding\ (VR) = \frac{hyskragafstand}{lasafstand} = \frac{2D}{d_1 - d_2}$$

5.2 $$Meganiese\ voordeel\ (MA) = \frac{Las\ (W)}{Hyskrag\ (F)}$$

5.3 $$Meganiese\ effektiwiteit\ (\eta_{meg}) = \frac{MA}{VR} \times 100\%$$

6. HEFBOME

6.1 $$Meganiese\ voordeel\ (MA) = \frac{Las\ (W)}{Hyskrag\ (F)}$$

6.2 $$Insetbeweging\ (IM) = hyskrag \times afstand\ beweeg\ deur\ hyskrag$$

6.3 $$Uitsetbeweging\ (OM) = Las \times afstand\ beweeg\ deur\ las$$

6.4 $$Snelheidsverhouding\ (VR) = \frac{Insetbeweging}{Uitsetbeweging}$$

7. SKROEFDRADE

7.1 $$Effektiewe\ diameter = Buitediameter - \tfrac{1}{2}\ steek$$

7.2 $$Gemiddelde\ omtrek = \pi \times effektiewe\ \ diameter$$

7.3 $$Styging = steek \times getal\ beginne$$

7.4 $$Helikshoek:\ \tan\theta\ = \frac{Styging}{Gemiddelde\ omtrek}$$

7.5 $$Ingryphoek = 90° - (helikshoek + vryloophoek)$$

7.6 $$Sleephoek = 90° + (helikshoek - vryloophoek)$$

7.7 $$Getal\ draaie = \frac{hoogte}{styging}$$

2. WRYWINGSKOPPELAARS

2.1 $Wringkrag\ (T) = \mu WnR$

waar μ = wrywingskoëffisiënt
W = totale druk
n = getal wrywingsoppervlakke
R = effektiewe radius

2.2 $Drywing\ (P) = \frac{2\pi NT}{60}$

3. SPANNING EN VORMVERANDERING

3.1 $Spanning = \frac{Krag}{Oppervlakte} \quad of \quad (\sigma = \frac{F}{A})$

3.2 $Vormverandering\ (\varepsilon) = \frac{verandering\ in\ lengte\ (\Delta L)}{oorspronklike\ lengte\ (L)}$

3.3 $Young\ se\ modulus\ (E) = \frac{spanning}{vormverandering} \quad of \quad (\frac{\sigma}{\varepsilon})$

3.4 $A_{as} = \frac{\pi d^2}{4}$

3.5 $A_{pyp} = \frac{\pi(D^2 - d^2)}{4}$

4. HIDROULIKA

4.1 $Druk\ (P) = \frac{Krag\ (F)}{Oppervlakte\ (A)}$

4.2 $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

4.3 *Volume = Dwarsdeursneeoppervlakte × slaglengte (l of s)*

4.4 *Arbeid verrig = krag × afstand*

FORMULEBLAD VIR MEGANIESE TEGNOLOGIE – GRAAD 12

1. BANDAANDRYWINGS

1.1 $Bandspoed = \frac{\pi DN}{60}$

1.2 $Bandspoed = \frac{\pi\ (D + t) \times N}{60}$ $(t = banddikte)$

1.3 $Bandmassa = Area \times lengte \times digtheid$ $(A = dikte \times wydte)$

1.4 $Spoedverhouding\ = \frac{Diameter\ van\ gedrewe\ katrol}{Diameter\ van\ dryfkatrol}$

1.5 $N_1D_1 = N_2D_2$

1.6 $Oopbandlengte = \frac{\pi(D + d)}{2} + \frac{(D - d)^2}{4c} + 2c$

1.7 $Gekruisdeband\,lengte = \frac{\pi(D + d)}{2} + \frac{(D + d)^2}{4c} + 2c$

1.8 $Drywing\ (P) = \frac{2\pi NT}{60}$

1.9 $Verhouding\ tussen\ die\ stywe\text{-}\ en\ slapkant = \frac{T_1}{T_2}$

1.10 $Drywing\ = \frac{(T_1 - T_2)\,\pi\ D\ N}{60}$ waar T_1 = krag in die stywekant

1.11 $Wydte\ = \frac{T_1}{Toelaatbare\ trekkrag}$

6.5 'n Enkelplaatwrywingskoppelaar word gebruik om drywing oor te dra vanaf die enjin na die ratkashoofas. Die plaat het 'n effektiewe diameter van 180 mm met wrywingsmateriaal aan weerskante met 'n wrywingskoëffisiënt van 0,45. Die totale toegepaste krag op die drukplaat is 3,5 kN.

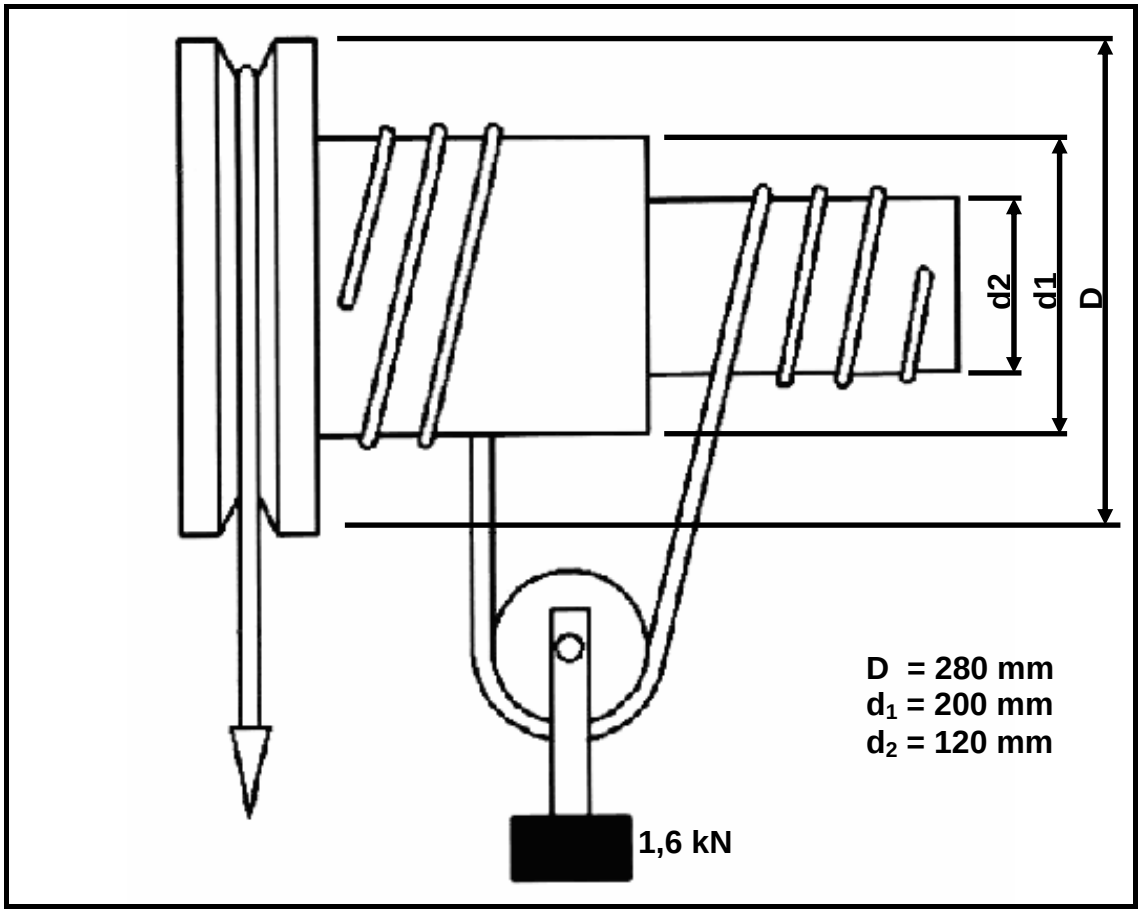
Bepaal, deur middel van berekeninge, die volgende:

6.5.1 Die maksimum wringkrag wat oorgedra kan word (3)

6.5.2 Die drywing wat teen 4 500 r/min, in kW oorgedra word (3)
[50]

TOTAAL: 200

6.4 'n Differensiaal-wiel-en-as-hysmasjien word in FIGUUR 6.3 getoon en het 'n meganiese voordeel van 4. 'n Las van 1,6 kN word gehys wanneer 'n krag toegepas word. Die diameters van die katrolle is 280 mm, 200 mm en 120 mm onderskeidelik.



FIGUUR 6.3

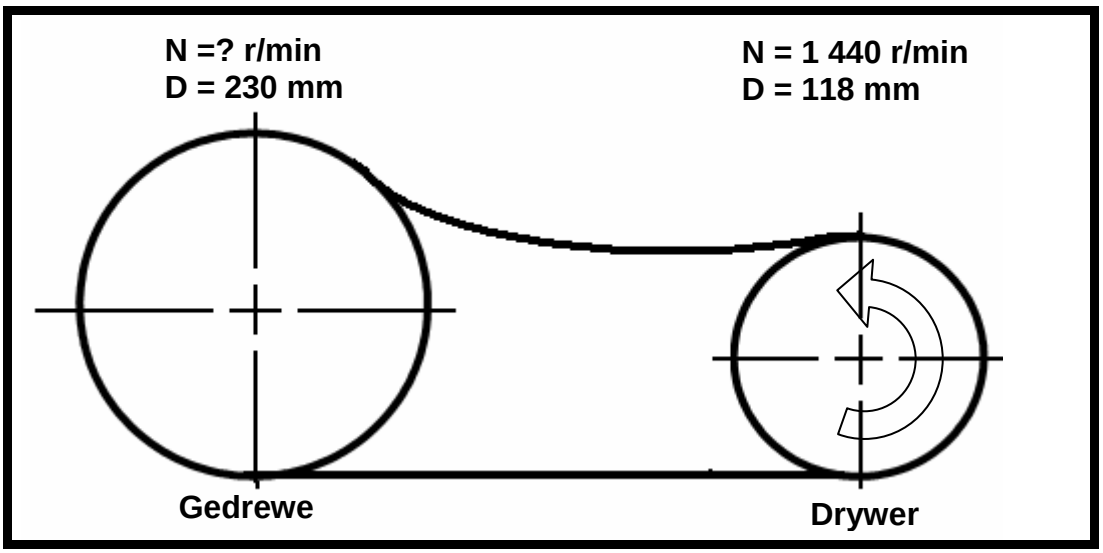
Bepaal, deur middel van berekeninge, die volgende:

6.4.1 Die krag wat toegepas word (3)

6.4.2 Die snelheidsverhouding (3)

6.4.3 Die meganiese doeltreffendheid (3)

6.3 Die bandaandrywing van 'n waterpomp word in FIGUUR 6.2 getoon. Die dryfkatrol op die elektriese motor het 'n diameter van 118 mm en roteer teen 1 440 r/min terwyl die gedrewe katrol 'n diameter van 230 mm het.



FIGUUR 6.2

Bepaal, deur middel van berekeninge, die volgende:

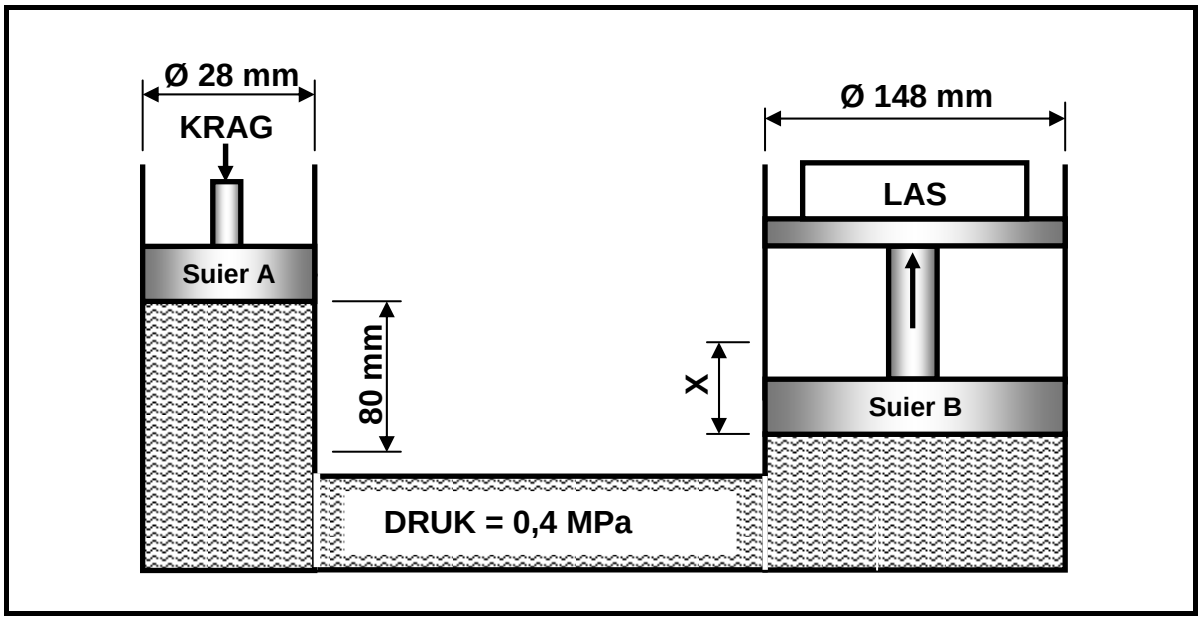
6.3.1 Die rotasiefrekwensie van die gedrewe katrol in r/min (3)

6.3.2 Die bandspoed van die stelsel in meter per sekonde (3)

6.3.3 Die drywing oorgedra in dié stelsel indien die verhouding tussen die trekkrag in die stywe kant en die trekkrag in die slap kant 2,5 : 1 is. Die trekkrag in die stywe kant is 300 N. (5)

VRAAG 6: KRAGTE, STELSELS EN BEHEER

6.1 'n Hidrouliese stelsel word gebruik om masjienonderdele tydens die monteringsproses te beweeg. Die spesifikasies van die stelsel word diagrammaties in FIGUUR 6.1 voorgestel.



FIGUUR 6.1

Bepaal, deur middel van berekeninge, die volgende:

6.1.1 Die krag wat op suier A toegepas word (5)

6.1.2 Die afstand X, in millimeter, wat suier B in 10 slae van suier A sal beweeg (7)

6.2 'n Las van 12 kN veroorsaak 'n trekspanning van 24,5 MPa in 'n ronde geelkoperstaaf. Die oorspronklike lengte van die staaf is 250 mm en Young se modulus vir geelkoper is 90 GPa.

Bepaal, deur middel van berekeninge, die volgende:

6.2.1 Die diameter, in millimeter, van die geelkoperstaaf (6)

6.2.2 Die verandering in lengte, in millimeter, wat deur die las veroorsaak word (6)

VRAAG 5: INSTANDHOUDING EN TURBINES

5.1 Oliefilters word gebruik om die enjinolie skoon te hou om die leeftyd van die enjin te verleng. Verduidelik puntsgewys hoe jy 'n oliefilter van 'n enjin sal vervang tydens die diens van 'n voertuig. (5)

5.2 Noem DRIE redes waarom enjinolie vervang moet word. (3)

5.3 Hoe sal jy in staat wees om outomatieseratkasolie te identifiseer? (2)

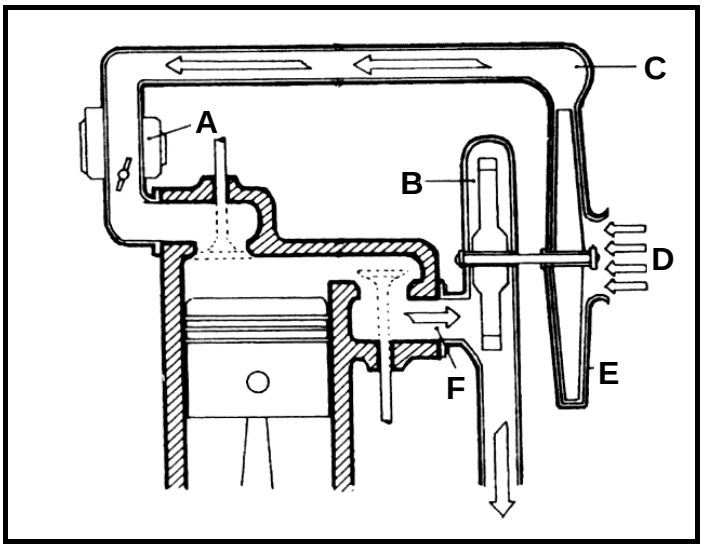
5.4 Laers speel 'n baie belangrike rol wanneer dit kom by die gladde werking van onderdele.

5.4.1 Noem DRIE ladings waaraan 'n laer onderwerp word. (3)

5.4.2 Noem DRIE oorsake van laeroorverhitting. (3)

5.4.3 Gee TWEE redes vir die ghriessmering van 'n wiellaer. (4)

5.5 'n Groot hoeveelheid voertuie maak van turboaanjaers gebruik om sodoende hul werkverrigting te verbeter. 'n Turboaanjaeropstelling word in FIGUUR 5.1 getoon.



FIGUUR 5.1

5.5.1 Benoem die onderdele volgens die letters A–F. (6)

5.5.2 Verduidelik die werking van die turbo-aanjaer. (6)

5.5.3 Waarom word 'n turboaangejaagde enjin met 'n olieverkoeler toegerus? (2)

5.6 Noem VIER voordele van 'n gasturbine, soos dit in 'n straalvliegtuig gebruik word. (4)

5.7 Noem TWEE metodes wat gebruik kan word om 'n superaanjaer aan te dryf. (2)

[40]

4.6 Twee ratte wat met mekaar inkam, moet vervaardig word. Die een rat moet 56 tande hê, met 'n SSD van 126 mm, terwyl die ander rat 39 tande en 'n SSD van 87,75 mm moet hê.

Bepaal, deur middel van berekeninge, die volgende:

4.6.1 Die module van die klein rat (2)

4.6.2 Die module van die groot rat (2)

4.6.3 Die buitediameter van die groot rat (3)

4.6.4 Die dedendum van die groot rat (2)

4.6.5 Die vry ruimte van die groot rat (2)

4.6.6 Die indeksering wat nodig is om die groot rat te sny (3)

4.7 Noem DRIE tipes nie-destruktiewe toetse wat op sweislasse uitgevoer kan word (3)

4.8 Noem TWEE moontlike oorsake van elk van die volgende sweisdefekte:

4.8.1 Onvolledige deurdringing (2)

4.8.2 Poreusheid (2)

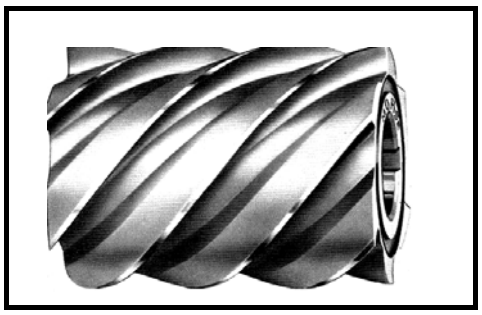
4.8.3 Sweiskraters (2)

4.9 Noem TWEE veiligheidsmaatreëls wat nagekom moet word wanneer die Brinell-hardheidstoetser gebruik word. (2)

4.10 Noem VIER veiligheidsmaatreëls wat nagekom moet word wanneer 'n laer- en rattrekker gebruik word. (4)
[50]

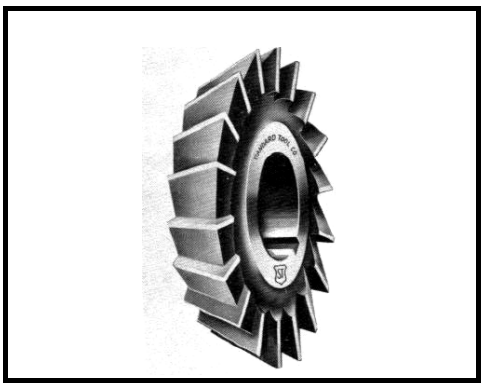
4.5 Identifiseer die volgende freessnyers wat in FIGUUR 4.2 getoon word:

4.5.1



(1)

4.5.2

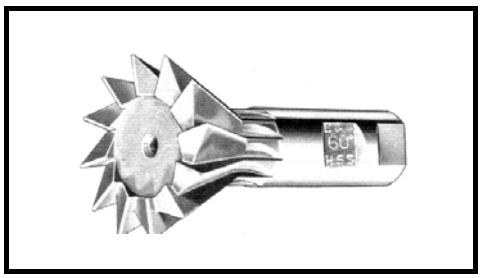


(1)

4.5.3

(1)

4.5.4

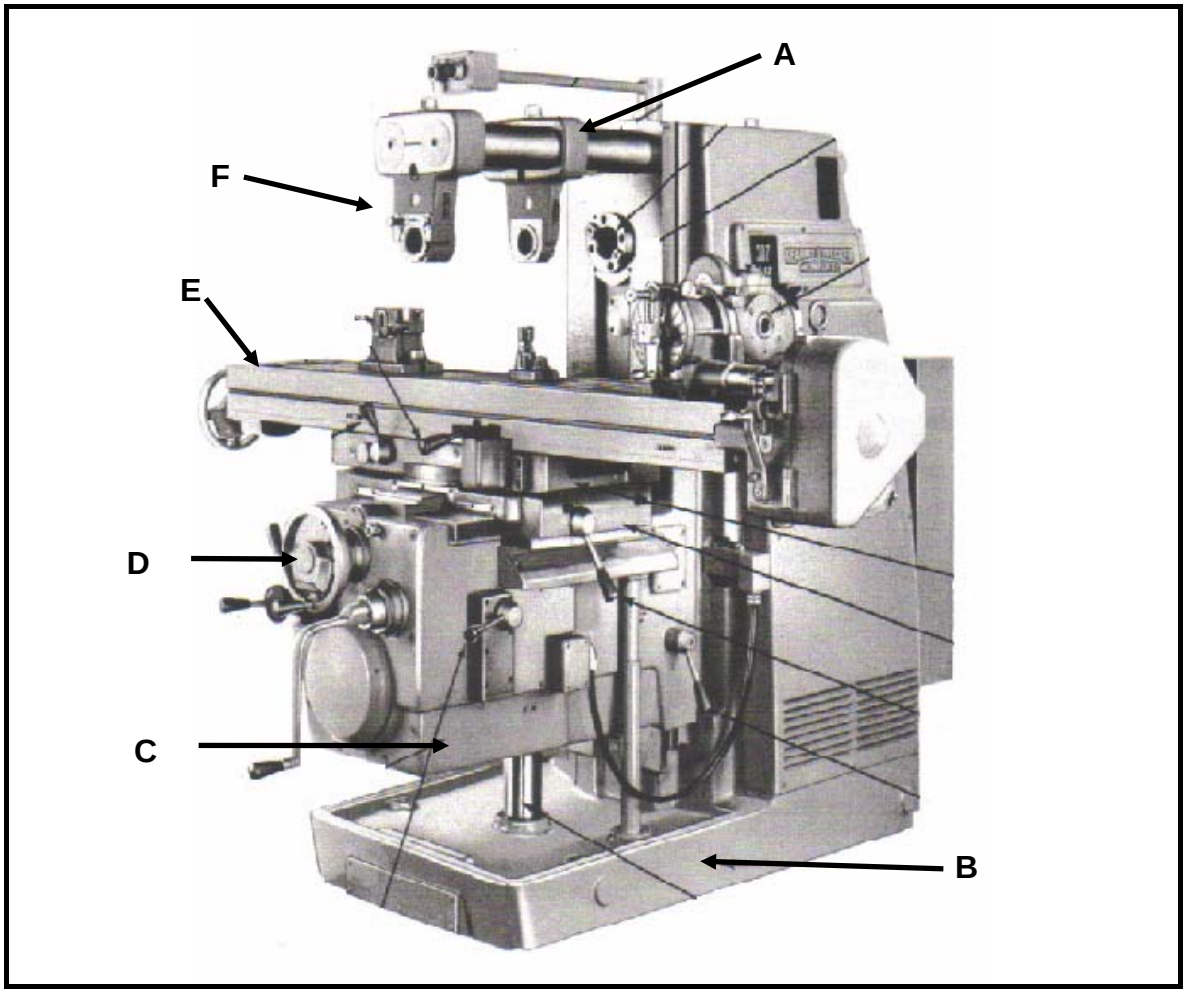


(1)

FIGUUR 4.2

VRAAG 4: VEILIGHEID, TERMINOLOGIE EN HEGTINGSMETODES

4.1 'n Freesmasjien word in FIGUUR 4.1 getoon. Benoem die onderdele volgens die letters A–F.



FIGUUR 4.1 (6)

4.2 Noem die metode wat gebruik word om kantdruk van 'n heliese freessnyer tydens die freesproses teen te werk. (2)

4.3 Bereken die tafeltoevoer in millimeter per minuut van 'n 140 mm-diameter snyer met 46 tande, wat teen 'n snyspoed van 120 meter per minuut en 'n toevoer van 0,1 mm per tand werk. (6)

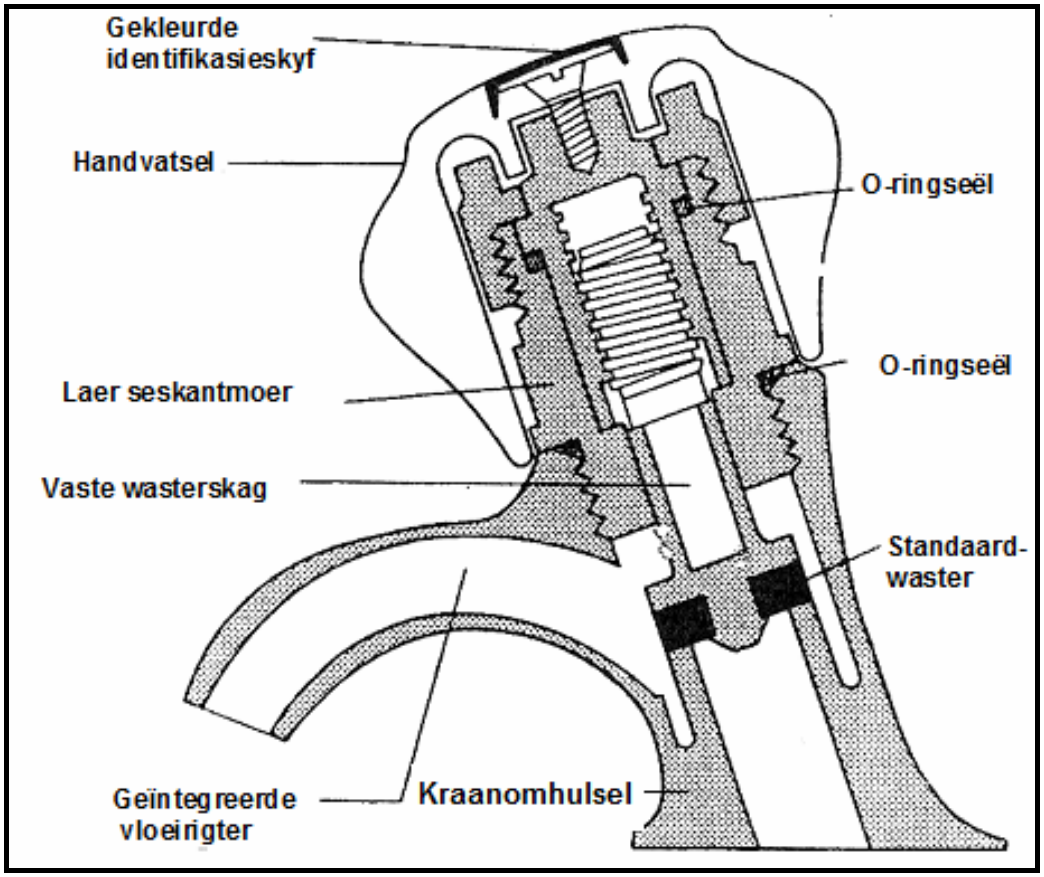
4.4 Noem die indekseringsmetode wat vir die volgende gebruik word:

4.4.1 Die wurm en wurmwiel is ontkoppel (1)

4.4.2 Die getal indelings is nie deur 40 deelbaar nie en die gatsirkels maak nie voorsiening vir die getal indelings nie (1)

4.4.3 Sny van 'n seskant op 'n as (1)

3.4 'n Dwarsdeursneeaansig van 'n kraan wat vir 'n handewasbak gebruik word, word in FIGUUR 3.2 getoon. Die kraanomhulsel is van 'n nie-ysterhoudende legering vervaardig.



FIGUUR 3.2

3.4.1 Identifiseer die nie-ysterhoudende legering wat vir die vervaardiging van die kraanomhulsel geskik sal wees. (2)

3.4.2 Identifiseer die materiaal wat vir die vaste wasterskag geskik sal wees. (1)

3.4.3 Identifiseer die materiaal wat vir die handvatsel geskik sal wees. (1)

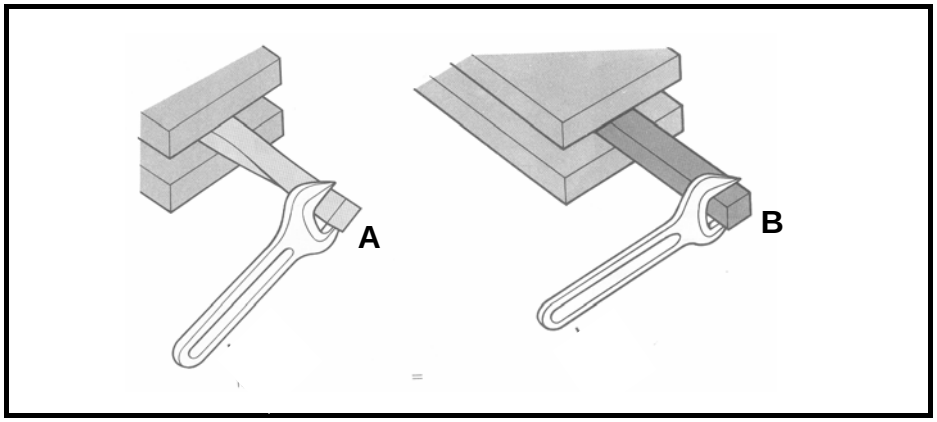
3.4.4 Noem VIER gemeenskaplike eienskappe van metale wat vir die vervaardiging van die waterkraanomhulsel gebruik kan word. (4)

3.4.5 Wat is die funksie van die O-ringseëls? (2)
[20]

VRAAG 3: MATERIALE

3.1 Noem TWEE hoofelemente van ysterhoudende legerings. (2)

3.2 Twee verskillende materiale, A en B, word in FIGUUR 3.1 getoon. Albei word aan dieselfde krag wat wringspanning in die materiaal veroorsaak, onderwerp.



FIGUUR 3.1

3.2.1 Identifiseer die materiaal met die hoogste wringweerstand. (1)

3.2.2 Gee 'n rede vir jou antwoord op VRAAG 3.2.1. (2)

3.3 Ontwikkeling in ingenieursmateriale en hul toepassings, het gelei tot verskeie innoverende deurbrake in die vervaardigingsbedryf, soos byvoorbeeld nie-ysterhoudende legerings.

3.3.1 Wat verstaan jy onder 'n *nie-ysterhoudende legering*? (2)

3.3.2 Noem DRIE voorbeelde van nie-ysterhoudende legerings. (3)

VRAAG 2: GEREEDSKAP EN TOERUSTING

2.1 Mnr. Zungu het 'n silinderlekkasietoets uitgevoer en het sekere resultate bereik. Noem EEN moontlike resultaat en die fout op die silinder. (2)

2.2 'n Gasanaliseerder is 'n belangrike gereedskapstuk wat gebruik word om die uitlaatgasse van 'n binnebrandenjin te analiseer. Noem TWEE redes vir 'n hoë CO-lesing. (2)

2.3 Noem die doel van die volgende toetse wat op metale uitgevoer word:

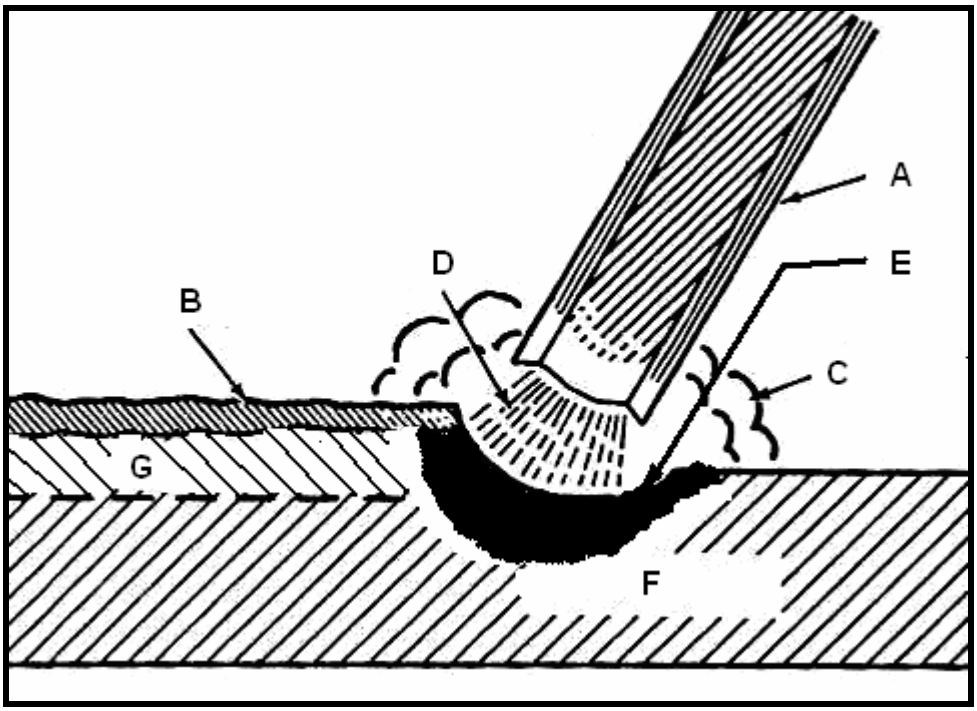
2.3.1 Trektoets (2)

2.3.2 Balkbuigtoets (2)

2.4 Noem TWEE tipes hardheidstoetsers. (2)

2.5 Noem DRIE funksies van 'n multimeter. (3)

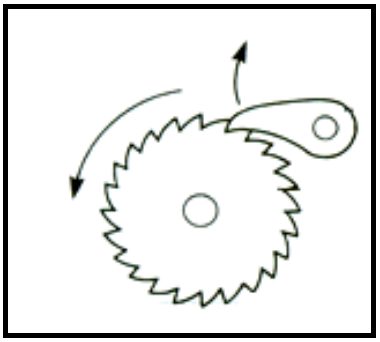
2.6 Die MAGS-sweisspuitstuk word tydens die sweisproses in FIGUUR 2.1 getoon. Benoem die onderdele volgens die letters A–G.



FIGUUR 2.1 (7)

[20]

1.18 Identifiseer die meganisme wat in FIGUUR 1.9 getoon word.



FIGUUR 1.9

A Sperrat en klink
B Wurm en wurmwiel
C Wiel en kleinrat
D Drywer en gedrewe (1)

1.19 Wat is die funksie van die uitlaatgas-hekklep ('waste gate') in 'n turboaanjaer?

A Laat oormaat druk vry
B Laat oormaat vog vry
C Laat oormaat hitte vry
D Laat oormaat olie uit (1)

1.20 Wat sal die volumetriese doeltreffendheid wees indien 'n 100 mm^3-blaser 79 mm^3 per omwenteling verplaas?

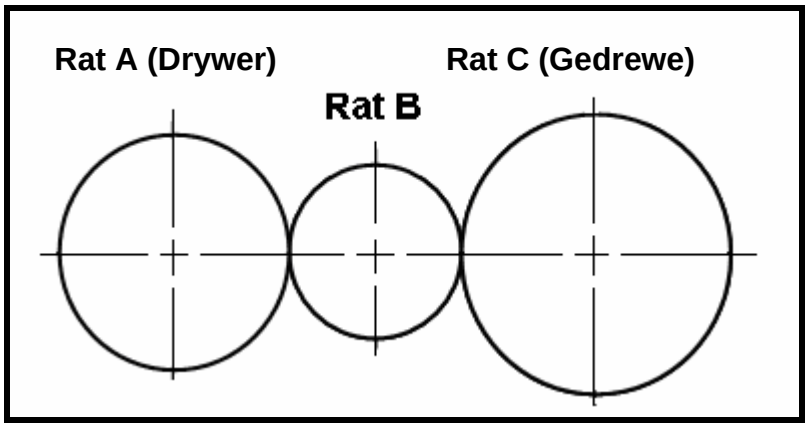
A 100%
B 79%
C 21%
D 179% (1)

[20]

1.15 Watter EEN van die volgende is 'n voordeel van 'n ketting-aandrywingstelsel?

A Lae koste
B Benodig geen smering
C Gladde funksionering
D Glipvrye aandrywing (1)

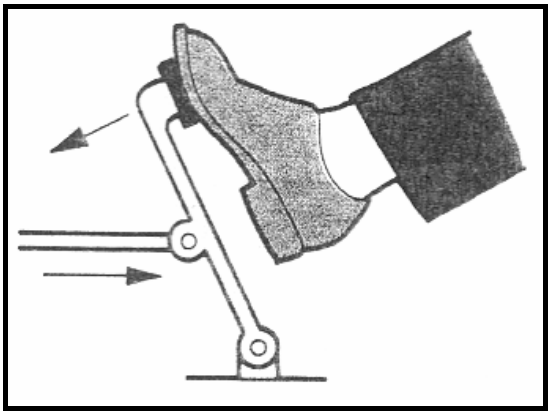
1.16 FIGUUR 1.7 toon drie ratte wat met mekaar inkam. Wat word rat B genoem?



FIGUUR 1.7

A Heliese rat
B Ratstang
C Tussenrat
D Kleinrat (1)

1.17 Watter klas hefboom word in FIGUUR 1.8 getoon?



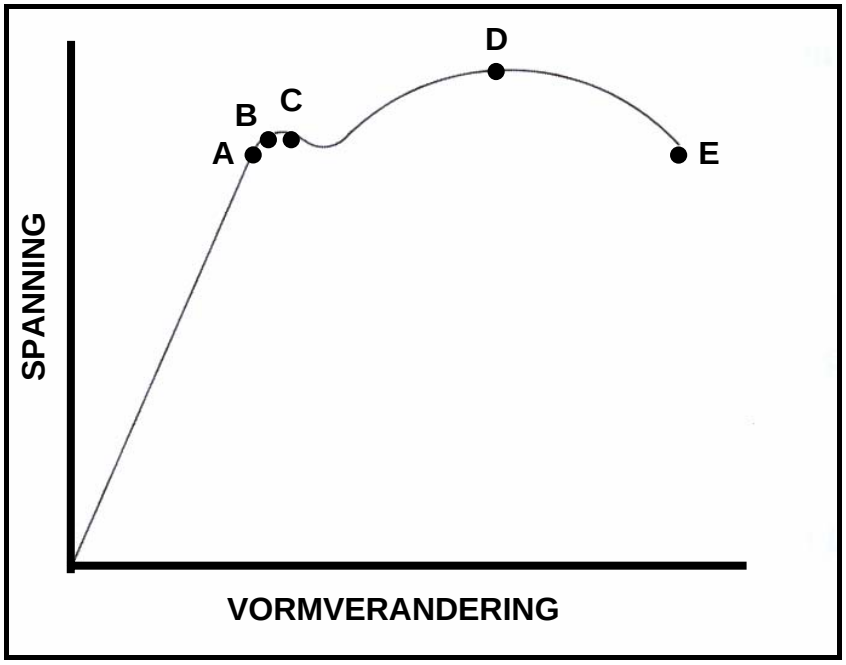
FIGUUR 1.8

A Eerste
B Tweede
C Derde
D Vierde (1)

1.11 In 'n trektoets …

A word 'n toetsstuk tot breekpunt belas.
B word balke gebruik om die sweisstruktuur te bepaal.
C word 'n hamer gebruik om die toetsmateriaal te breek.
D word vloeibare kleurstof gebruik om sweisdefekte op te spoor. (1)

1.12 Die spanning-vormveranderingsgrafiek vir laekoolstaal word in FIGUUR 1.5 getoon. Wat verteenwoordig punt A in die grafiek?



FIGUUR 1.5

A Onderste breekpunt
B Maksimum spanning
C Boonste breekpunt
D Eweredigheidsgrens (1)

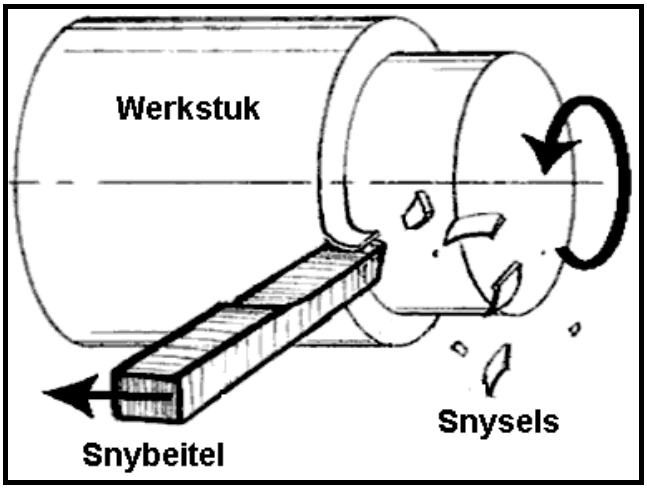
1.13 Wat word onder die term *spanning* verstaan?

A Verhouding tussen die krag en die dwarsdeursnee-oppervlakte
B Verhouding tussen die toename in lengte en die oorspronklike lengte
C Verhouding tussen die spanning en die toegepaste krag
D Verhouding tussen die krag en die oorspronklike lengte (1)

1.14 Watter EEN van die volgende is 'n funksie van 'n wrywingskoppelaar?

A Dit ondersteun ligte radiale laste.
B Dit dra drywing teen hoë snelhede oor.
C Dit ondersteun hoëdruklaste.
D Dit dra 'n kombinasie van radiale en aksiale laste. (1)

1.8 Watter draaibankproses word in FIGUUR 1.3 getoon?



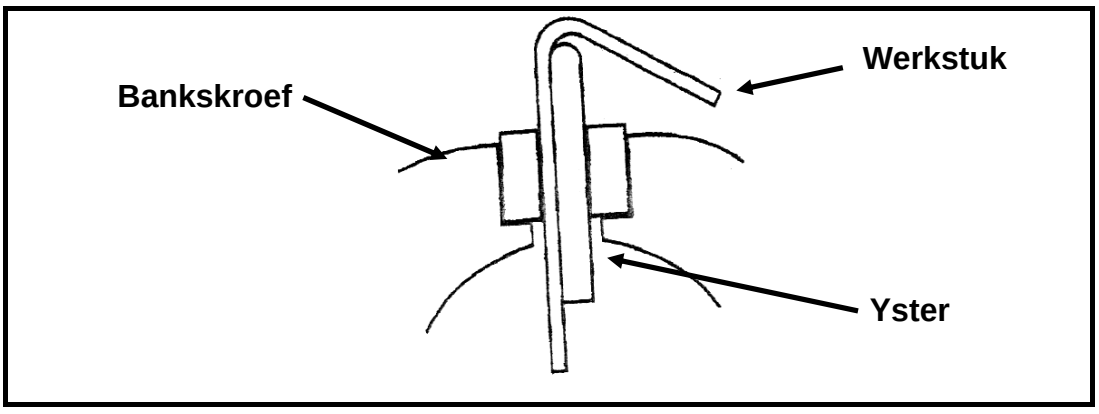
FIGUUR 1.3

A Parallelsnywerk
B Boorwerk
C Ruiming
D Draadsnywerk (1)

1.9 Watter EEN van die volgende is 'n voordeel van klimfreeswerk?

A Die afwerking is fyner.
B Growwe toevoer kan gebruik word.
C Minder vibrasie word ervaar.
D Die spanning op die spil en die snyer is minder. (1)

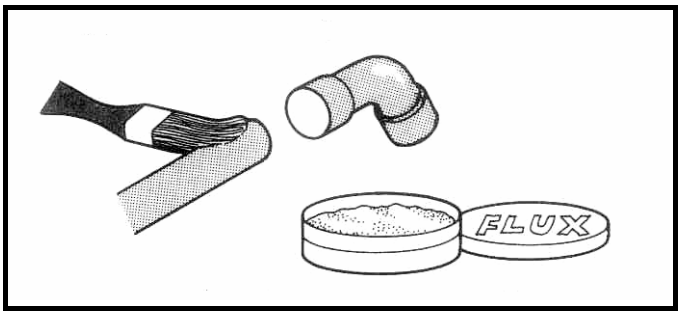
1.10 Watter tipe toets word in FIGUUR 1.4 getoon?



FIGUUR 1.4

A Eenvoudige gidsbuigtoets
B Vrybuigtoets
C 180°-gidsbuigtoets
D 180°-geslote buigtoets (1)

1.5 Wat is die doel vir die gebruik van 'n smeltmiddel ('flux') tydens sag soldering, soos in FIGUUR 1.1 getoon?



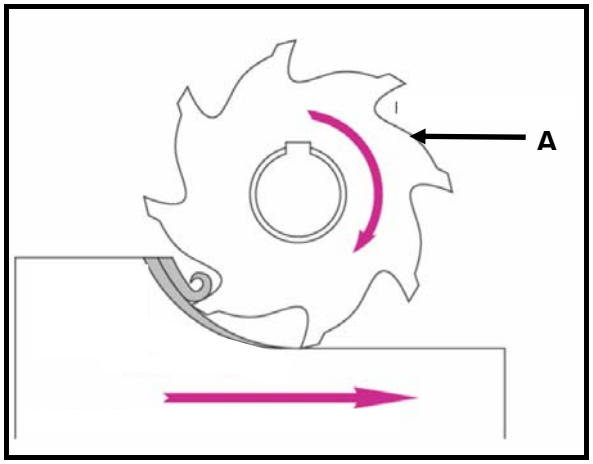
FIGUUR 1.1

A Verseker dat daar geen sweiskraters voor kom nie
B Verseker dat die verhitte oppervlak glad is
C Verseker dat die gesoldeerde las sterk is
D Verseker dat die verhitte oppervlak chemies skoon is (1)

1.6 Wat is *termoplastiese materiale*?

A Materiale wat gerek kan word en dan weer na hul oorspronklike vorm terugkeer
B Materiale wat met verhitting versag en met afkoeling weer verhard
C Materiale wat nie deur verhitting vervorm kan word nie
D Materiale wat 'n vaste vorm onder druk aanneem (1)

1.7 FIGUUR 1.2 toon 'n bewerking om 'n werkstuk te masjineer. Identifiseer onderdeel A soos in die figuur getoon.



FIGUUR 1.2

A Entfrees
B Werkstuk
C Freessnyer
D Sirkelsaag (1)

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie opsies word as moontlike antwoorde vir die volgende vrae gegee. Kies die korrekte antwoord en maak 'n kruisie (X) in die blokkie (A–D) langs die vraagnommer (1.1–1.20) op die aangehegte ANTWOORDBLAD.

VOORBEELD:

1.21	A	B	C	D

1.1 Watter EEN van die volgende veiligheidmaatreëls is van toepassing op 'n freesmasjien?

A Die materiaal wat gesaag moet word, moet stewig in die skroef geklamp word.
B Die klembussleutel moet altyd verwyder word.
C Moenie oor of naby die draaiende snyer strek nie.
D Maak seker dat die lemme stewig vasgemaak is. (1)

1.2 Watter EEN van die volgende veiligheidmaatreëls hou verband met 'n momente-en-kragtetoetser?

A Verwyder die primêre spoeldraad om vonke te voorkom.
B Wanneer koelmiddel gekontamineer is, moet dit vervang word.
C Maak seker dat die lemme stewig vas is.
D Maak seker dat die voorwerp wat getoets word, stewig vas is. (1)

1.3 Wat is die funksie van 'n wringtoetser?

A Dit meet die weerstand van die materiaal teen 'n statiese krag.
B Dit meet die vloei van uitlaatgasse.
C Dit meet die verdraaiing in 'n onderdeel weens twee teenmomente op die langsas daarvan.
D Dit meet die stroomvloei in 'n stroombaan. (1)

1.4 Beskerming van die boog en die gesmelte sweisplas teen atmosferiese gasse, is die funksie van die …

A trae gas.
B uitlaatgas.
C inlaatgas.
D lugbrandstofmengsel. (1)

INSTRUKSIES EN INLIGTING

1. Skryf jou sentrum- en eksamennommer in die spasies wat op die ANTWOORDEBOEK en ANTWOORDBLAD verskaf word.

2. Lees AL die vrae aandagtig deur.

3. Beantwoord AL die vrae.

4. Beantwoord die vrae in VRAAG 1 op die aangehegte ANTWOORDBLAD. Plaas die voltooide ANTWOORDBLAD in die ANTWOORDEBOEK.

5. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.

6. Begin ELKE vraag op 'n NUWE bladsy.

7. Toon ALLE berekeninge en eenhede. Rond finale antwoorde tot TWEE desimale plekke af.

8. Kandidate mag nieprogrammeerbare/wetenskaplike sakrekenaars en teken-/ wiskundige instrumente gebruik.

9. Die waarde van die gravitasiekrag moet as 10 m/s^2 geneem word.

10. Alle afmetings is in millimeter, tensy anders in die vraag genoem word.

11. Skryf netjies en leesbaar.

12. Gebruik die kriteria hieronder om jou met die beplanning van jou tyd te help.

VRAAG	ASSESSERING-STANDAARDE	INHOUD	PUNTE	TYD
1	1–9	Meervoudigekeuse-vrae	20	18 minute
2	2	Gereedskap en Toerusting	20	18 minute
3	3	Materiale	20	18 minute
4	1, 4 en 5	Veiligheid, Terminologie en Hegtingsmetodes	50	45 minute
5	7 en 9	Instandhouding en Turbines	40	36 minute
6	6 en 8	Kragte, Stelsels en Beheer	50	45 minute
		TOTAAL	**200**	**180 minute**

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NASIONALE SENIOR SERTIFIKAAT

GRAAD 12

MEGANIESE TEGNOLOGIE

FEBRUARIE/MAART 2012

PUNTE: **200**

TYD: **3 uur**

Hierdie vraestel bestaan uit 19 bladsye, 'n 5 bladsy-formuleblad en 1 antwoordblad.

* M C H T D M *

EASTERN CAPE