basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY

FEBRUARY/MARCH 2014

MARKS: 200

TIME: 3 hours

This question paper consists of 16 pages and a 5-page formula sheet.

* M C H T D M *

EASTERN CAPE

INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the spaces provided 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/mathematical 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. Write neatly and legibly.
11. Use the criteria below to assist you in managing your time.

QUESTION	CONTENT	MARKS	TIME
1	Multiple-choice questions	20	18 minutes
2	Tools and equipment	20	18 minutes
3	Materials	20	18 minutes
4	Safety, terminology and joining methods	50	45 minutes
5	Maintenance and turbines	40	36 minutes
6	Forces and systems and control	50	45 minutes
	TOTAL	**200**	**180 minutes**

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are given as possible answers to the following questions. Choose the 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 D.

1.1 Which ONE of the following actions is considered dangerous when operating a lathe?

A Wearing eye protection
B Wearing correct clothing
C Measuring while the work piece is rotating
D Operating the lathe with all guards in place (1)

1.2 Which ONE of the following safety regulations applies to the MAGS/MIGS welding process?

A Check the colour coding on cylinders.
B Hold the work piece in your hand during the welding process.
C Turn the relief valve very slowly.
D Ensure that the welding area is well ventilated. (1)

1.3 Which advanced engineering equipment is used to determine the amount of twisting of a bar?

A Torsion tester
B Brinell tester
C Tensile tester
D Spring tester (1)

1.4 Carbon steels are classified according to the percentage of carbon content. High-carbon steel contains less than ... of carbon.

A 0,10%
B 0,30%
C 1,50%
D 0,60% (1)

1.5 ... is added to steel when toughness, hardness and wear resistance are desired.

A Bronze
B Solder
C Vanadium
D Lead (1)

1.6 Identify the equipment used for a testing procedure in FIGURE 1.1 below.

FIGURE 1.1

A Gas analyser
B Spring tester
C Brinell hardness tester
D Torsion tester (1)

1.7 Identify the milling process in FIGURE 1.2 below.

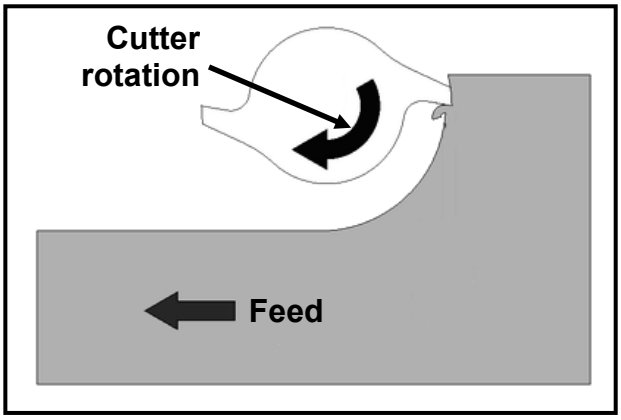


FIGURE 1.2

A Down-cut milling
B Up-cut milling
C Straddle milling
D Slab milling (1)

1.8 What is the advantage of down-cut milling?

A Greater cutting depth is obtained.
B The feed of the table must be slower.
C The method is subjected to vibration.
D Looseness (slack) in the table feed screw must be eliminated. (1)

1.9 Identify the milling cutter in FIGURE 1.3 below.

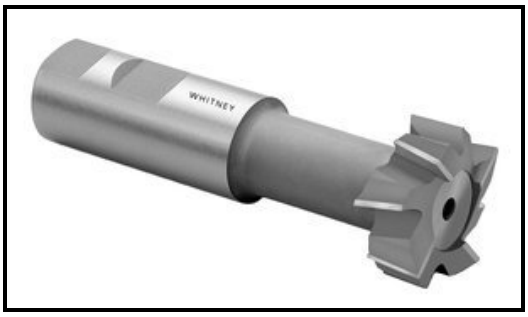


FIGURE 1.3

A Dovetail cutter
B Side-and-face cutter
C T-slot cutter
D Equal-angle cutter (1)

1.10 What do you understand by the *nick-break test*?

A Breaking a weld open to examine external defects
B Checking shear fractures of a weld
C Checking high-frequency sound effects
D Breaking open a welded joint to examine internal defects (1)

1.11 Porosity of a welded joint refers to …

A metal found in weld metal due to surface contamination.
B small pinholes in weld metal due to atmospheric contamination.
C occurs as a cavity at the end of a welded joint.
D occurs as a cavity at the beginning of a welded joint. (1)

1.12 What will the induced stress be if a load of 50 N is applied to a square bar with a cross-sectional area of 144×10^{-6} m^2?

A 347 kPa
B 3,47 kPa
C 0,347 kPa
D 34,7 kPa (1)

1.13 What does point **X** represent in the stress/strain diagram in FIGURE 1.4 below?

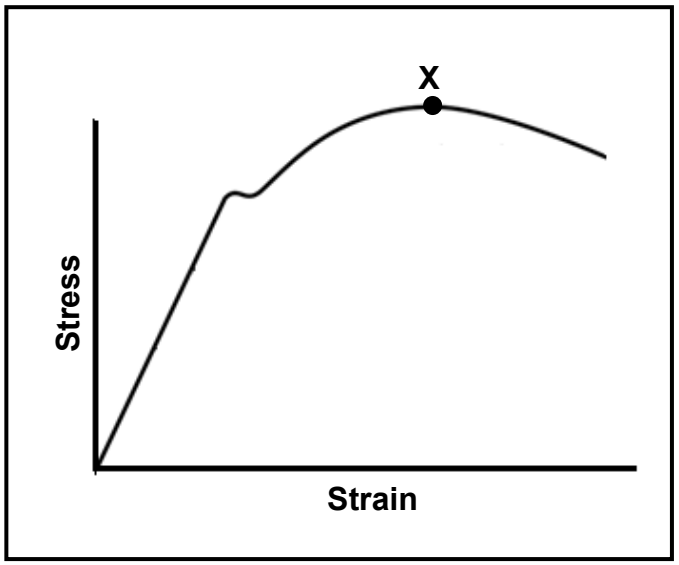


FIGURE 1.4

A Limit of proportionality
B Elastic limit
C Maximum stress
D Yield point (1)

1.14 What does the abbreviation EP stand for in terms of lubricating oil?

A External pressure
B Extreme pressure
C Excess pressure
D Extra pressure (1)

1.15 What is the purpose of a cutting fluid?

A Act as a non-lubricant
B Make chips stick to the cutter
C Reduce the quality of the finish
D Cools a cutting tool (1)

1.16 What is the velocity ratio of the pulley system in FIGURE 1.5 below if the smaller pulley is the driver pulley?

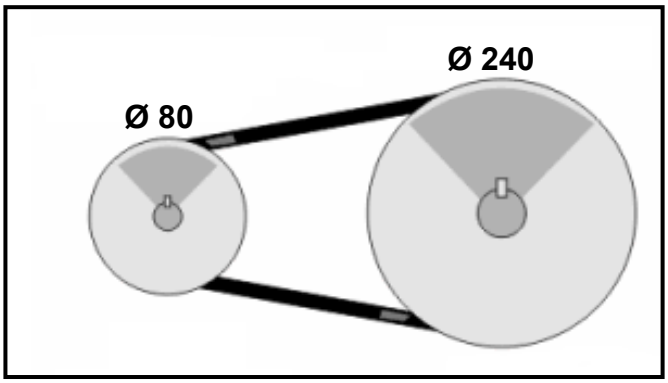


FIGURE 1.5

A 3 : 1
B 24 : 1
C 8 : 1
D 32 : 1 (1)

1.17 Identify the mechanism in FIGURE 1.6 below.

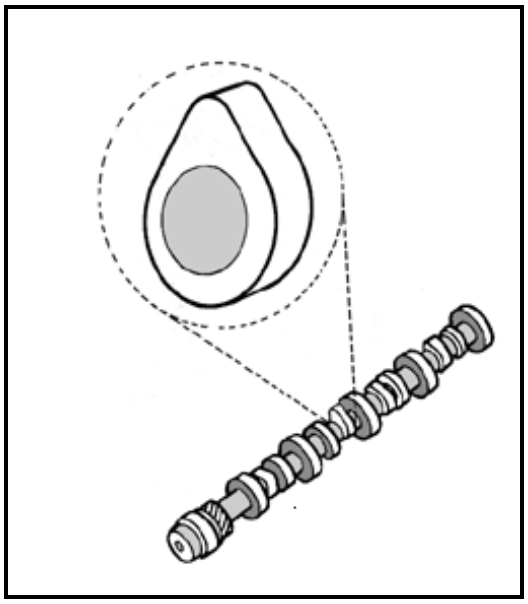


FIGURE 1.6

A Cam follower
B Cam guide
C Cam and shaft
D Cam rod (1)

1.18 FIGURE 1.7 below shows a rack and pinion as used in the movement of the saddle of a lathe. Choose the correct statement from those given below if the pinion is the driver gear.

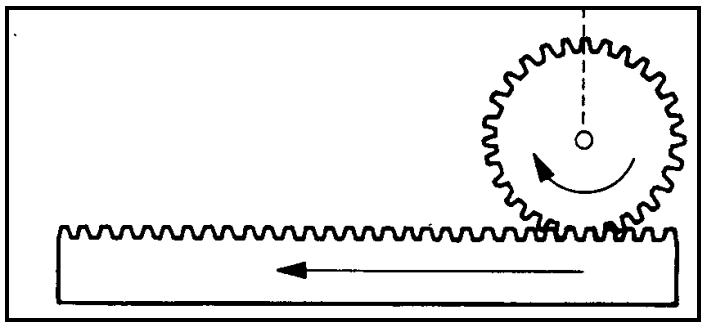


FIGURE 1.7

A Converts linear motion to rotary motion
B Converts rotary motion to linear motion
C Converts reciprocating motion to linear motion
D Converts linear motion to reciprocating motion (1)

1.19 A turbocharger is driven by …

A gears.
B inlet gases.
C a camshaft.
D exhaust gases. (1)

1.20 Scavenging is defined as the removal of ...

A burned gases and filling of the combustion chamber with fresh air.
B fresh air and filling of the combustion chamber with burned gases.
C fuel and filling with fresh air.
D an air and fuel mixture from the combustion chamber. (1)

[20]

QUESTION 2: TOOLS AND EQUIPMENT

2.1 Mr Jack needs to carry out a dry compression test on his vehicle's engine. Explain the procedure he needs to follow to carry out the test. (8)

2.2 Define the following with reference to the testing of materials:

2.2.1 Bending test (2)

2.2.2 Tensile test (2)

2.3 Name FOUR measurements that can be taken with a multimeter. (4)

2.4 FIGURE 2.1 below shows a test using the Brinell hardness tester. Label the sketch (A–D).

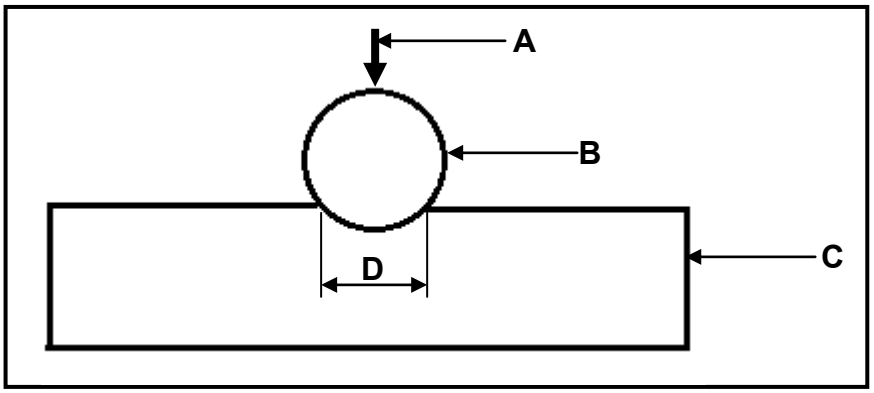


FIGURE 2.1 (4)

[20]

QUESTION 3: MATERIALS

3.1 FIGURE 3.1 below shows a hammer used in the general engineering environment. Answer the questions that follow.

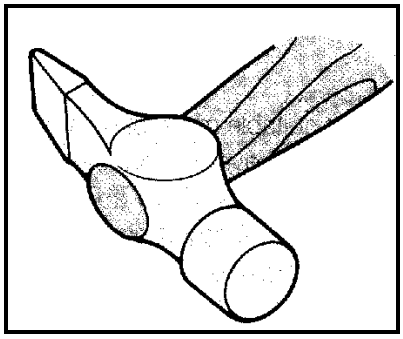


FIGURE 3.1

3.1.1 What type of material is used in the manufacturing of the hammer head? (1)

3.1.2 Give TWO reasons for using the material in QUESTION 3.1.1. (2)

3.1.3 Why is it advisable to subject the hammer head to heat treatment? (2)

3.2 FIGURE 3.2 below shows the frame of a greenhouse made from stainless steel tubing. Answer the questions that follow.

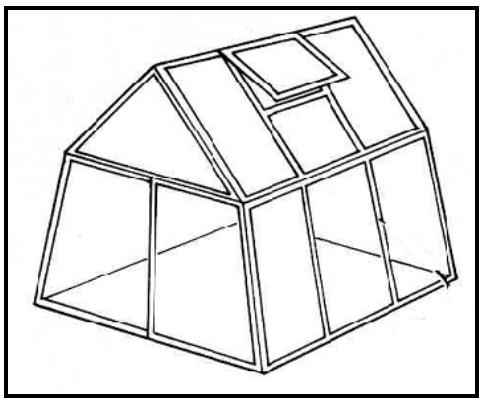


FIGURE 3.2

3.2.1 Which THREE properties make stainless steel suitable for this product (frame)? (3)

3.2.2 Why was tubing used rather than solid bar? (2)

3.2.3 What will be the disadvantage if mild steel is used to manufacture the frame? (2)

3.3 FIGURE 3.3 below shows an electrical three-pin plug. Answer the questions that follow.

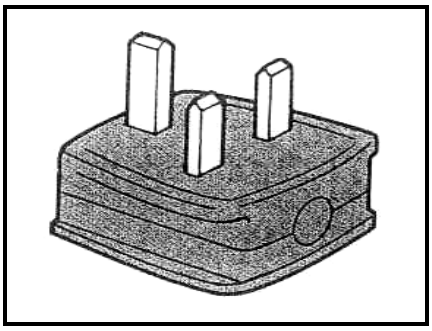


FIGURE 3.3

3.3.1 Which type of material is used to manufacture the pins? Give TWO reasons for your answer. (3)

3.3.2 Which type of material is used to manufacture the casing? Give TWO reasons for your answer. (3)

3.4 FIGURE 3.4 below shows a car bumper made from carbon fibre. State TWO properties of carbon fibre which make it suitable for use in the manufacturing of bumpers.

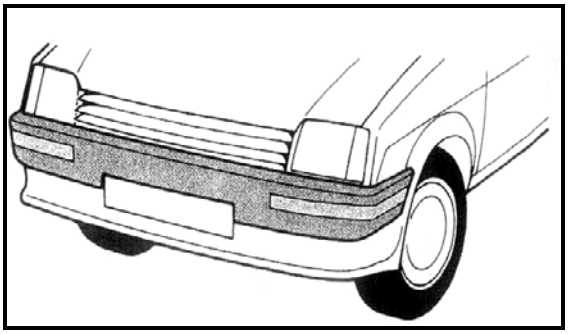


FIGURE 3.4 (2)
[20]

QUESTION 4: SAFETY, TERMINOLOGY AND JOINING METHODS

4.1 Solly uses a milling machine to manufacture a hexagonal bolt head. State FOUR safety rules for the safe use of a milling machine. (4)

4.2 Rudy uses spring compressors to install coil springs in a vehicle's suspension. State TWO safety rules that he must consider for the safe handling of the spring compressors. (2)

4.3 List THREE important safety precautions that should be observed during the MIGS/MAGS welding process. (3)

4.4 Calculate the simple indexing for a gear with 17 teeth. (5)

4.5 A gear with 91 teeth has to be machined on a milling machine.
(HINT: Use N = 90 divisions or A = 90 divisions and n = 91 for the calculations.)

4.5.1 Calculate the indexing required. (5)

4.5.2 Calculate the change gears required. (6)

4.6 FIGURE 4.1 below shows a schematic drawing of the MIGS/MAGS welding process. Label parts A–G.

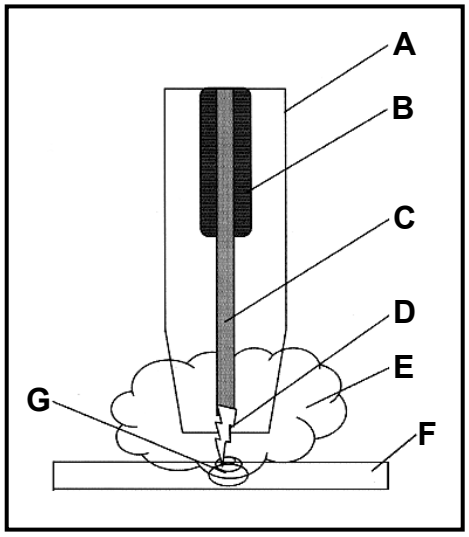


FIGURE 4.1 (7)

4.7 State ONE use of the following milling cutting tools:

4.7.1 T-slot milling cutter (1)

4.7.2 End mill cutter (1)

4.7.3 Slitting saw (1)

4.7.4 Form (profile) cutter (1)

4.8 Enid works for Shai Boilers as a learner boilermaker. Help Enid by answering the following questions:

4.8.1 Name TWO causes of porosity in a welded joint and ONE way to prevent it. (3)

4.8.2 Explain TWO steps to follow to prevent slag inclusion in a welded joint. (2)

4.8.3 Define the term *distortion* as used in welding. (2)

4.8.4 State THREE factors that need to be considered during the arc welding process to ensure a good weld. (3)

4.8.5 List FOUR advantages of MIGS/MAGS welding. (4)
[50]

QUESTION 5: MAINTENANCE AND TURBINES

5.1 A great amount of money is spent on maintenance due to bearing failure. Give FOUR reasons for bearing failure. (4)

5.2 Why is it important to fit an oil seal to the crankshaft of an internal combustion engine? (2)

5.3 Explain the terms *corrosion resistance* and *rust resistance* in motor oil. (2)

5.4 Give FOUR reasons for using a cutting fluid when a centre lathe is used. (4)

5.5 Most motor vehicle manufacturers recommend that gearbox oil be changed every 50 000 km. Describe the procedure for draining the old oil and filling the gearbox with new oil. (8)

5.6 Some people like to increase the performance of their vehicles by using the blower in FIGURE 5.1 below. Answer the questions that follow.

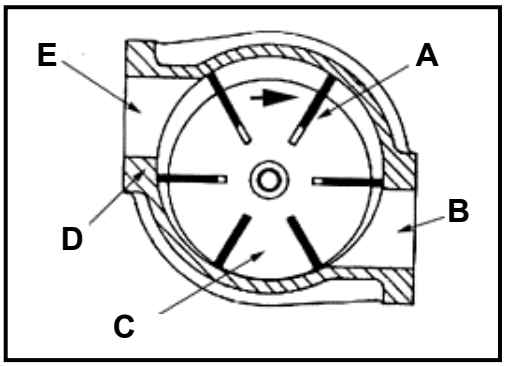


FIGURE 5.1

5.6.1 Identify the type of blower in FIGURE 5.1. (1)

5.6.2 Label parts A–E of the blower. (5)

5.6.3 Explain the operation of the blower in FIGURE 5.1. (5)

5.7 How are turbochargers and superchargers driven? (2)

5.8 Outline THREE advantages of a supercharger. (3)

5.9 State THREE advantages of a steam turbine. (3)

5.10 State ONE disadvantage of a steam turbine. (1)

[40]

QUESTION 6: FORCES AND SYSTEMS AND CONTROL

6.1 A 3,5 m long steel wire with a cross-sectional area of 10,08 x 10^{-3} m^2 hangs vertically with a 3 kN load attached to it. The load causes an increase of 0,5 mm in the length of the wire.

6.1.1 Name the type of stress in the wire material. (1)

Determine by means of calculations:

6.1.2 The stress in the wire material (Answer in MEGA magnitude.) (4)

6.1.3 The strain caused by the load (3)

6.1.4 The elasticity modulus for this material (3)

6.2 The gear system in FIGURE 6.1 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.

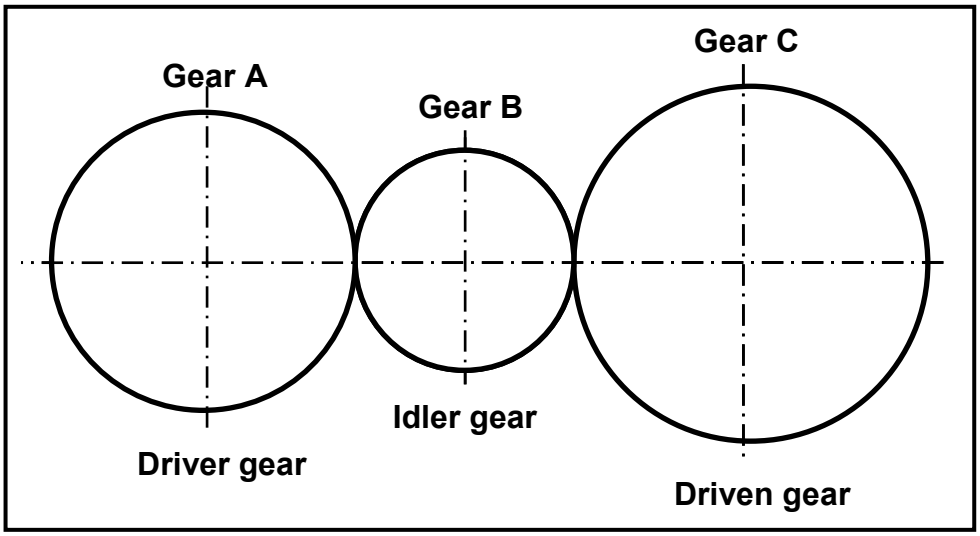


FIGURE 6.1

6.2.1 Determine by means of calculations:

(a) The number of teeth on the idler gear (4)

(b) The rotation frequency of the driven gear (4)

6.2.2 In which direction will the driven gear rotate if the driver gear rotates anti-clockwise? (2)

6.3 A drilling machine must be driven at 15 r/s from a pulley with a diameter of 640 mm and a rotation frequency of 9,4 r/s. The tensile force in the tight side of the belt is 320 N. The ratio of the tensile force in the tight side to the tensile force in the slack side is 2,5 **:** 1. (The thickness of the belt must be ignored.)

Determine by means of calculations:

6.3.1 The diameter of the pulley needed on the drilling machine (4)

6.3.2 The power that can be transmitted (6)

6.4 A diagrammatic representation of a hydraulic press is shown in FIGURE 6.2 below. An applied force of 0,9 kN is needed to complete one stroke of 126 mm. The diameter of piston A is 40 mm and the diameter of piston B is 240 mm.

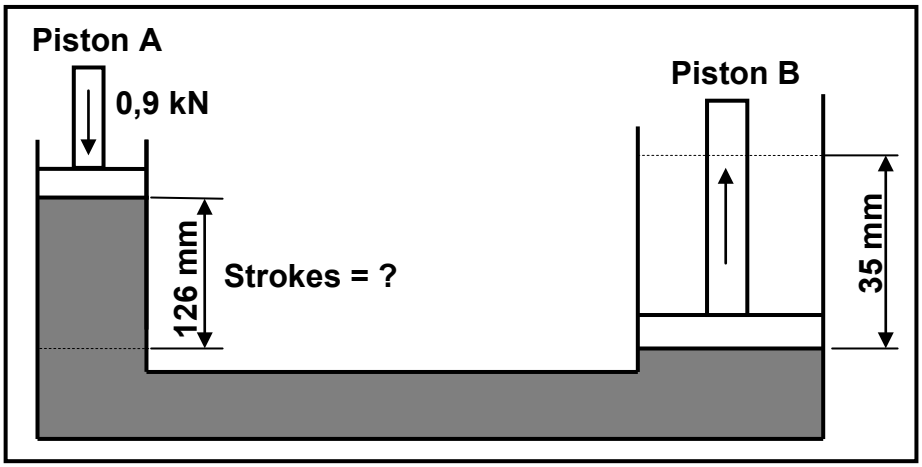


FIGURE 6.2

Determine by means of calculations:

6.4.1 The pressure in the system (5)

6.4.2 The number of strokes by piston A needed to lift piston B 35 mm. The system has been equipped with the necessary one-way valves to supply adequate hydraulic fluid and pressure during the process. (9)

6.5 A single-plate friction clutch is used to transmit 240 Nm torque in an engine/ generator combination. The clutch plate has friction material on both sides. The friction coefficient is 0,6. The total applied force onto the pressure plate is 3,4 kN. Calculate the effective diameter of the clutch plate. (5)

[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 $Power\ (P) = \frac{2\pi N T}{60}$

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

1.10 $Power\ (P) = \frac{(T_1 - T_2)\,\pi\,D\,N}{60}$ where $T_1 = force\ in\ the\ tight\ side$

$T_2 = force\ on\ slack\ side$

$T_1 - T_2 = effective\ force\ (T_e)$

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

3. STRESS AND STRAIN

3.1 $Stress = \frac{force}{area}$ or $(\sigma = \frac{F}{A})$

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

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

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

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

4. HYDRAULICS

4.1 $Pressure\ (P) = \frac{force\ (F)}{area\ (A)}$

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

4.3 $Work\ done = force \times distance$

4.4 $Volume = cross\text{-}sectional\ area \times stroke\ length\ (l\ or\ s)$

5. WHEEL AND AXLE

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

5.2 $$Mechanical\ advantage\ (MA) = \frac{load\ (W)}{effort\ (F)}$$

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

6. LEVERS

6.1 $$Mechanical\ advantage\ (MA) = \frac{load\ (W)}{effort\ (F)}$$

6.2 $$Input\ movement\ (IM) = effort \times distance\ moved\ by\ effort$$

6.3 $$Output\ movement\ (OM) = load \times distance\ moved\ by\ load$$

6.4 $$Velocity\ ratio\ (VR) = \frac{input\ movement}{output\ movement}$$

7. SCREW THREADS

7.1 $$Pitch\ diameter = outside\ diameter - \tfrac{1}{2}\ pitch$$

7.2 $$Pitch\ circumference = \pi \times pitch\ diameter$$

7.3 $$Lead = pitch \times number\ of\ starts$$

7.4 $$Helix\ angle:\ \tan\theta = \frac{lead}{pitch\ circumference}$$

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

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

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

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 $Simple\ indexing = \frac{40}{n}$ *(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*

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 snyer*

N = *getal omwentelinge van snyer per minuut*

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

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

8. RATAANDRYWINGS

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

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

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

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

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

5. WIEL EN AS

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

5.2 $$\text{Meganiese voordeel } (MA) = \frac{\text{las } (W)}{\text{hyskrag } (F)}$$

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

6. HEFBOME

6.1 $$\text{Meganiese voordeel } (MA) = \frac{\text{las } (W)}{\text{hyskrag } (F)}$$

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

6.3 $$\text{Uitsetbeweging } (OM) = \text{las} \times \text{afstand beweeg deur las}$$

6.4 $$\text{Snelheidsverhouding } (VR) = \frac{\text{insetbeweging}}{\text{uitsetbeweging}}$$

7. SKROEFDRADE

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

7.2 $$\text{Steekomtrek} = \pi \times \text{steekdiameter}$$

7.3 $$\text{Styging} = \text{steek} \times \text{getal beginne}$$

7.4 $$\text{Helikshoek: } \tan\theta = \frac{\text{styging}}{\text{steekomtrek}}$$

7.5 $$\text{Ingryphoek} = 90° - (\text{helikshoek} + \text{vryloophoek})$$

7.6 $$\text{Sleephoek} = 90° + (\text{helikshoek} - \text{vryloophoek})$$

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

2. WRYWINGSKOPPELAARS

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

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

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

3. SPANNING EN VORMVERANDERING

3.1 $Spanning = \dfrac{krag}{oppervlakte}$ *of* $\left(\sigma = \dfrac{F}{A}\right)$

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

3.3 $Young\ se\ modulus\ (E) = \dfrac{spanning}{vormverandering}$ *of* $\left(\dfrac{\sigma}{\varepsilon}\right)$

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

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

4. HIDROULIKA

4.1 $Druk\ (P) = \dfrac{krag\ (F)}{oppervlakte\ (A)}$

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

4.3 *Arbeid verrig = krag × afstand*

4.4 *Volume = dwarsdeursnee-oppervlakte × slaglengte (l of s)*

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 = oppervlakte × lengte × digtheid (A = dikte × 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 $Gekruistebandlengte = \frac{\pi(D + d)}{2} + \frac{(D + d)^2}{4c} + 2c$

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

1.9 $Verhouding\ tussen\ die\ stywe\ kant\ en\ slap\ kant = \frac{T_1}{T_2}$

1.10 $Drywing\ (P) = \frac{(T_1 - T_2)\,\pi\,D\,N}{60}$

waar T_1 = krag in die stywe kant

T_2 = krag in die slap kant

$T_1 - T_2$ = effektiewe krag (T_e)

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

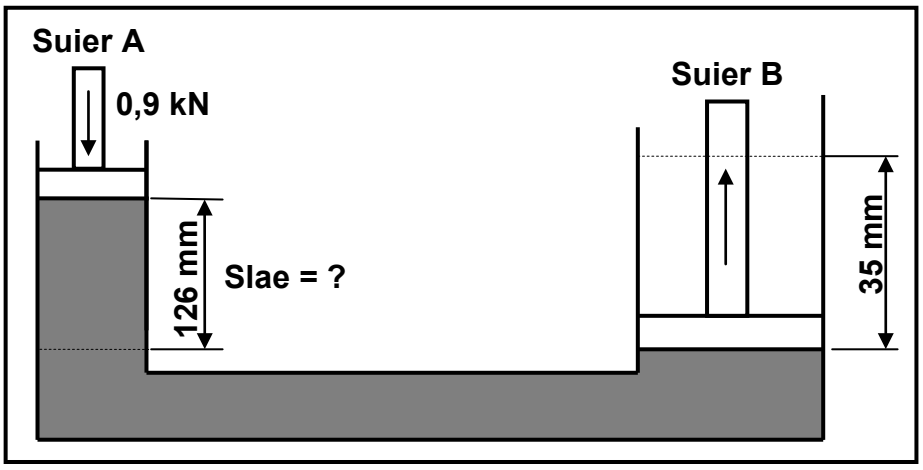
6.3 'n Boormasjien moet teen 15 r/s vanaf 'n katrol met 'n diameter van 640 mm en 'n rotasiefrekwensie van 9,4 r/s aangedryf word. Die trekkrag in die stywe kant van die band is 320 N. Die verhouding van die trekkrag in die stywe kant tot die trekkrag in die slap kant is 2,5 **:** 1. (Die dikte van die band moet buite rekening gelaat word.)

Bepaal deur middel van berekeninge:

6.3.1 Die diameter van die katrol wat op die boormasjien benodig word (4)

6.3.2 Die drywing wat oorgedra kan word (6)

6.4 'n Diagrammatiese voorstelling van 'n hidrouliese pers word in FIGUUR 6.2 hieronder getoon. 'n Toegepaste krag van 0,9 kN is nodig om een slag van 126 mm te voltooi. Die diameter van suier A is 40 mm en die diameter van suier B is 240 mm.



FIGUUR 6.2

Bepaal deur middel van berekeninge:

6.4.1 Die druk in die stelsel (5)

6.4.2 Die getal slae deur suier A wat nodig is om suier B 35 mm te lig. Die stelsel is met die nodige eenrigtingkleppe toegerus om genoeg hidrouliese vloeistof en druk gedurende die proses te voorsien. (9)

6.5 'n Enkelplaatwrywingskoppelaar word gebruik om 240 Nm wringkrag in 'n enjin/generator-kombinasie oor te dra. Die koppelaarplaat het wrywingsmateriaal aan beide kante. Die wrywingskoëffisiënt is 0,6. Die totale toegepaste druk op die drukplaat is 3,4 kN. Bereken die effektiewe diameter van die koppelaarplaat. (5)

[50]

TOTAAL: 200

VRAAG 6: KRAGTE EN STELSELS EN BEHEER

6.1 'n Staaldraad, 3,5 m lank, met 'n dwarsdeursnee-oppervlakte van 10,08 x 10^{-3} m^2 hang vertikaal met 'n 3 kN-las daaraan geheg. Die las veroorsaak 'n toename van 0,5 mm in die lengte van die draad.

6.1.1 Noem die tipe spanning in die draadmateriaal. (1)

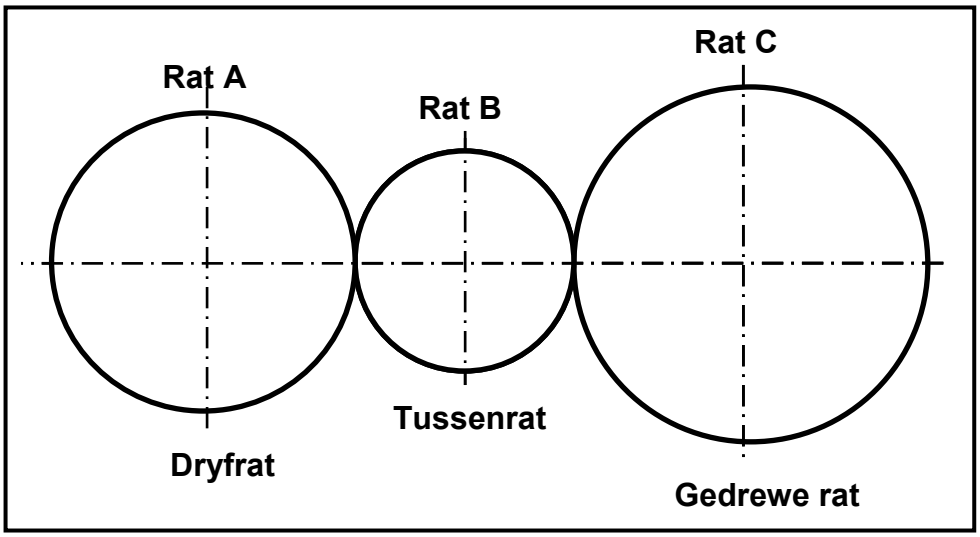
Bepaal deur middel van berekeninge:

6.1.2 Die spanning in die draadmateriaal (Antwoord in MEGA-grootheid.) (4)

6.1.3 Die vormverandering wat deur die las veroorsaak word (3)

6.1.4 Die elastisiteitsmodulus vir hierdie materiaal (3)

6.2 Die ratstelsel in FIGUUR 6.1 hieronder word gebruik om 'n hystoestel te beheer. Die dryfrat het 56 tande en roteer teen 700 r/min. Die tussenrat wat gebruik word om die rigting te verander, roteer teen 980 r/min. Die gedrewe rat het 64 tande.



FIGUUR 6.1

6.2.1 Bepaal deur middel van berekeninge:

(a) Die getal tande op die tussenrat (4)

(b) Die rotasiefrekwensie van die gedrewe rat (4)

6.2.2 In watter rigting sal die gedrewe rat roteer indien die dryfrat antikloksgewys roteer? (2)

VRAAG 5: INSTANDHOUDING EN TURBINES

5.1 Baie geld word aan instandhouding spandeer as gevolg van laerweiering. Gee VIER redes vir laerweiering. (4)

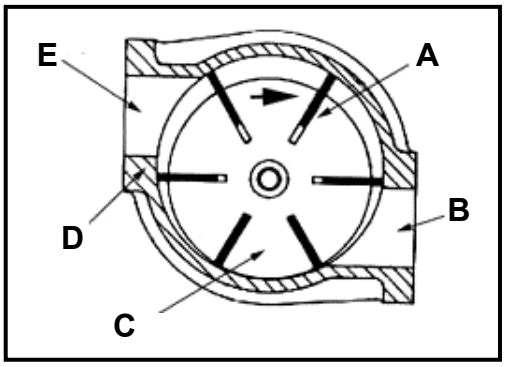
5.2 Hoekom is dit belangrik om 'n olieseël op die krukas van 'n binnebrandenjin te installeer? (2)

5.3 Verduidelik die terme *korrosieweerstand* en *roesweerstand* in motorolie. (2)

5.4 Gee VIER redes hoekom 'n snyvloeistof gebruik word wanneer 'n senterdraaibank gebruik word. (4)

5.5 Die meeste motorvoertuigvervaardigers beveel aan dat ratkasolie elke 50 000 km vervang word. Beskryf die prosedure vir die dreinering van die ou olie en die hervulling van die ratkas met nuwe olie. (8)

5.6 Sommige mense hou daarvan om hul voertuie se werkverrigting te verbeter deur die blaser in FIGUUR 5.1 hieronder te gebruik. Beantwoord die vrae wat volg.



FIGUUR 5.1

5.6.1 Identifiseer die tipe blaser in FIGUUR 5.1. (1)

5.6.2 Benoem onderdeel A–E van die blaser. (5)

5.6.3 Verduidelik die werking van die blaser in FIGUUR 5.1. (5)

5.7 Hoe word turbo-aanjaers en superaanjaers aangedryf? (2)

5.8 Noem DRIE voordele van 'n drukaanjaer ('supercharger'.) (3)

5.9 Noem DRIE voordele van 'n stoomturbine. (3)

5.10 Noem EEN nadeel van 'n stoomturbine. (1)

[40]

4.8 Enid werk vir Shai Boilers as 'n leerlingketelmaker. Help Enid deur die volgende vrae te beantwoord:

4.8.1 Noem TWEE oorsake van poreusheid in 'n sweislas en EEN manier om dit te voorkom. (3)

4.8.2 Verduidelik TWEE stappe wat gevolg moet word om slakinsluiting in 'n sweislas te voorkom. (2)

4.8.3 Definieer die term *kromtrekking* soos dit in sweiswerk gebruik word. (2)

4.8.4 Noem DRIE faktore wat tydens boogsweising in ag geneem moet word om 'n goeie sweislas te verseker. (3)

4.8.5 Noem VIER voordele van MIGS/MAGS-sweising. (4)
[50]

VRAAG 4: VEILIGHEID, TERMINOLOGIE EN HEGTINGSMETODES

4.1 Solly gebruik 'n freesmasjien om 'n seskantige boutkop te vervaardig. Noem VIER veiligheidsreëls vir die veilige gebruik van 'n freesmasjien. (4)

4.2 Rudy gebruik veerdrukkers om spiraalvere in 'n voertuig se veerstelsel te installeer. Noem TWEE veiligheidsreëls wat hy in ag moet neem vir die veilige hantering van die veerdrukkers. (2)

4.3 Noem DRIE belangrike veiligheidsmaatreëls wat tydens die MIGS/MAGS-sweisproses nagekom moet word. (3)

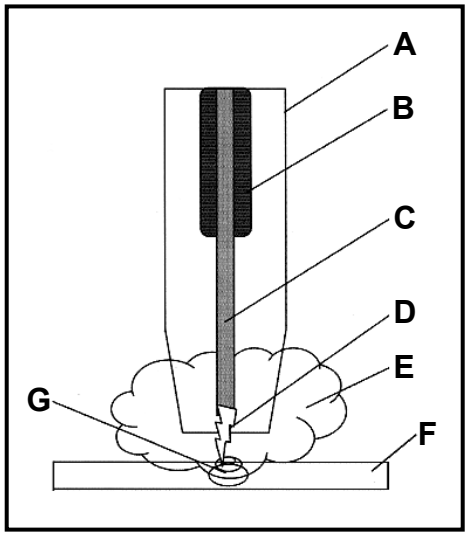
4.4 Bereken die eenvoudige indeksering vir 'n rat met 17 tande. (5)

4.5 'n Rat met 91 tande moet op 'n freesmasjien gemasjineer word.
(WENK: Gebruik N = 90 indelings of A = 90 indelings en n = 91 vir die berekeninge.)

4.5.1 Bereken die indeksering wat benodig word. (5)

4.5.2 Bereken die wisselratte wat benodig word. (6)

4.6 FIGUUR 4.1 hieronder toon 'n skematiese tekening van die MIGS/MAGS-sweisproses. Benoem deel A–G.



FIGUUR 4.1 (7)

4.7 Noem EEN gebruik van die volgende freessnygereedskap:

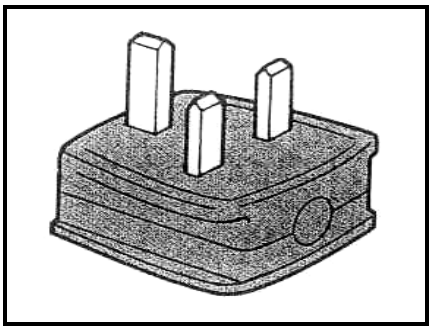
4.7.1 T-gleuffreessnyer (1)

4.7.2 Entfrees (1)

4.7.3 Saagfrees/Splytfrees (1)

4.7.4 Vormfrees (profielsnyer) (1)

3.3 FIGUUR 3.3 hieronder toon 'n elektriese driepuntprop. Beantwoord die vrae wat volg.

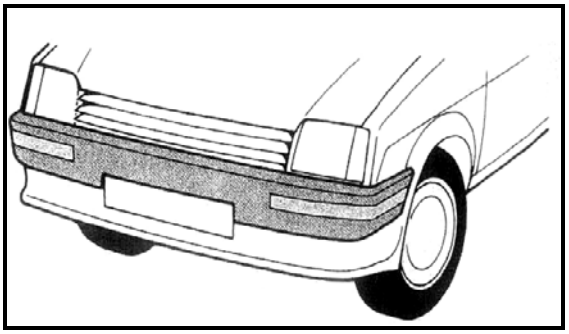


FIGUUR 3.3

3.3.1 Watter tipe materiaal word gebruik om die penne te vervaardig? Gee TWEE redes vir jou antwoord. (3)

3.3.2 Watter tipe materiaal word gebruik om die omhulsel te vervaardig? Gee TWEE redes vir jou antwoord. (3)

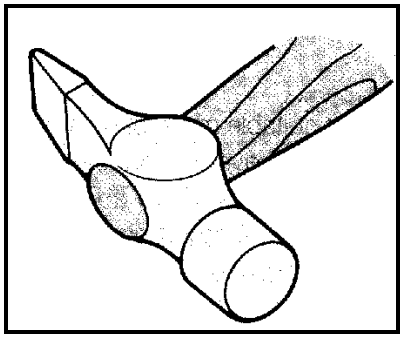
3.4 FIGUUR 3.4 hieronder toon 'n motor se buffer wat van koolstofvesel vervaardig is. Noem TWEE eienskappe van koolstofvesel wat dit geskik maak vir gebruik in die vervaardiging van buffers.



FIGUUR 3.4 (2)
[20]

VRAAG 3: MATERIALE

3.1 FIGUUR 3.1 hieronder toon 'n hamer wat in die algemene ingenieursomgewing gebruik word. Beantwoord die vrae wat volg.



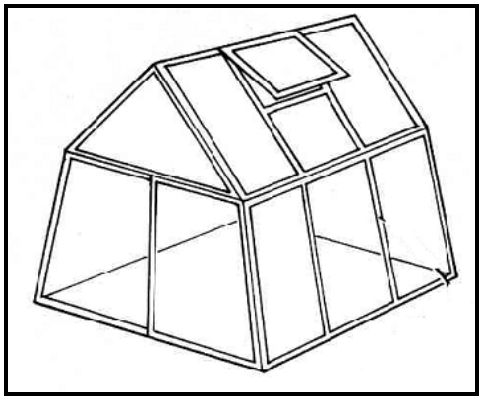
FIGUUR 3.1

3.1.1 Watter tipe materiaal word gebruik vir die vervaardiging van die hamerkop? (1)

3.1.2 Gee TWEE redes vir die gebruik van die materiaal in VRAAG 3.1.1. (2)

3.1.3 Waarom is dit voordelig om die hamerkop aan hittebehandeling te onderwerp? (2)

3.2 FIGUUR 3.2 hieronder toon die raam van 'n kweekhuis wat van vlekvryestaalpyp vervaardig is. Beantwoord die vrae wat volg.



FIGUUR 3.2

3.2.1 Watter DRIE eienskappe maak vlekvrye staal vir hierdie produk (raam) geskik? (3)

3.2.2 Hoekom is pyp eerder as soliede stawe gebruik? (2)

3.2.3 Wat sal die nadeel wees as sagte staal gebruik word om die raam te vervaardig? (2)

VRAAG 2: GEREEDSKAP EN TOERUSTING

2.1 Mnr. Jack moet 'n droë kompressietoets op sy voertuig se enjin uitvoer. Verduidelik die prosedure wat hy moet volg om die droë kompressietoets uit te voer. (8)

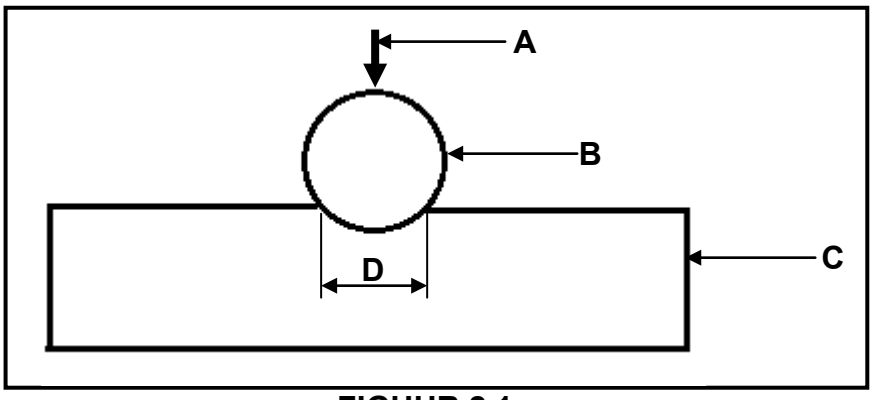
2.2 Definieer die volgende met verwysing na die toets van materiaal:

2.2.1 Buigtoets (2)

2.2.2 Trektoets (2)

2.3 Noem VIER afmetings wat met 'n multimeter geneem kan word. (4)

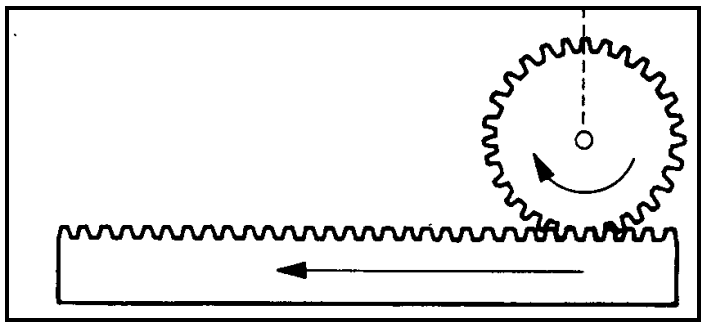
2.4 FIGUUR 2.1 hieronder toon 'n toets waar die Brinell-hardheidstoetser gebruik word. Benoem die skets (A–D).



FIGUUR 2.1

(4)
[20]

1.18 FIGUUR 1.7 hieronder toon 'n tandstang en kleinrat soos dit in die beweging van die saal van 'n draaibank gebruik word. Kies die korrekte stelling uit dié wat hieronder gegee word indien die kleinrat die dryfrat is.



FIGUUR 1.7

A Skakel lineêre beweging na rotasiebeweging om
B Skakel rotasiebeweging na lineêre beweging om
C Skakel wederkerige beweging na lineêre beweging om
D Skakel lineêre beweging na wederkerige beweging om (1)

1.19 'n Turbo-aanjaer word deur ... aangedryf.

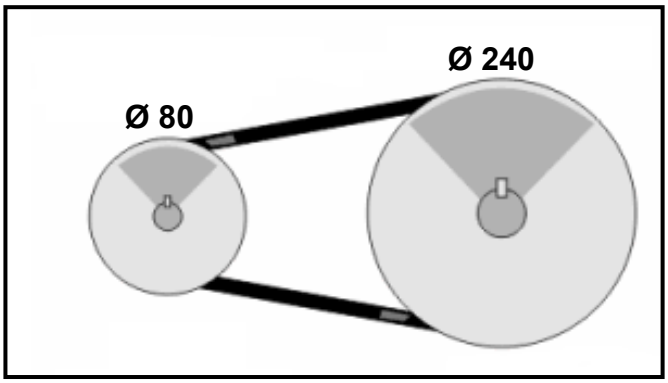
A ratte
B inlaatgasse
C 'n nokas
D uitlaatgasse (1)

1.20 Spoeling word gedefinieer as die verwydering van ...

A verbrande gasse en die vul van die verbrandingskamer met vars lug.
B vars lug en die vul van die verbrandingskamer met verbrande gasse.
C brandstof en vul met vars lug.
D 'n mengsel van lug en brandstof uit die verbrandingskamer. (1)

[20]

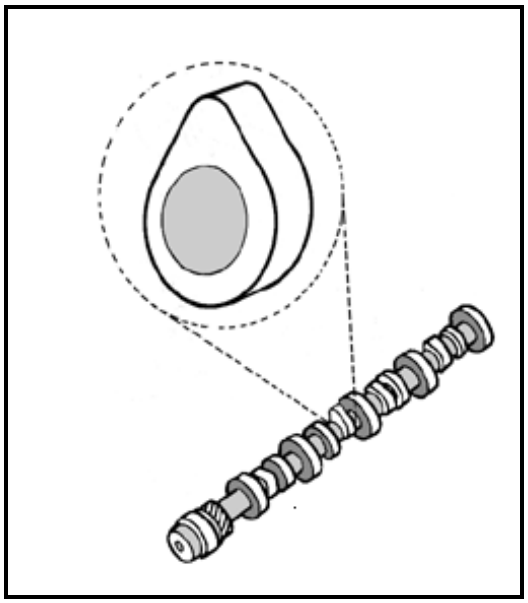
1.16 Wat is die snelheidsverhouding van die katrolstelsel in FIGUUR 1.5 hieronder as die kleiner katrol die dryfkatrol is?



FIGUUR 1.5

A 3 : 1
B 24 : 1
C 8 : 1
D 32 : 1 (1)

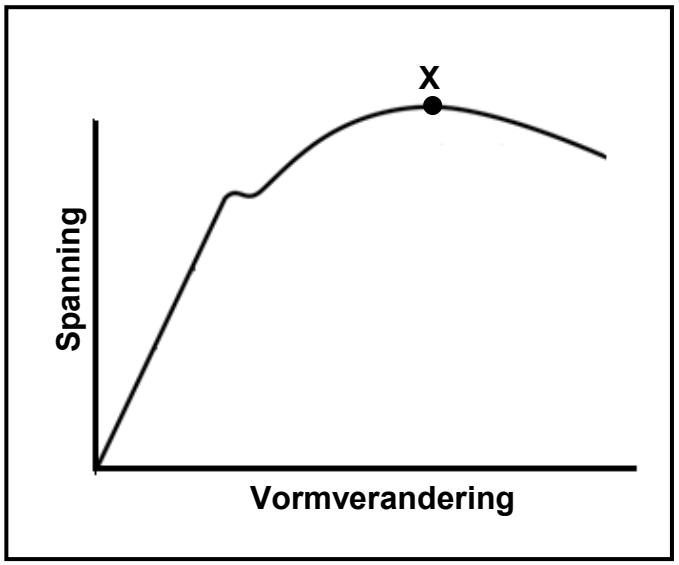
1.17 Identifiseer die meganisme in FIGUUR 1.6 hieronder.



FIGUUR 1.6

A Nokvolger
B Nokgids
C Nok en as
D Nokstang (1)

1.13 Wat stel punt **X** in die spanning-/vormveranderingsgrafiek in FIGUUR 1.4 hieronder voor?



FIGUUR 1.4

A Eweredigheidsgrens
B Elastisiteitsgrens
C Maksimum spanning
D Breekpunt (1)

1.14 Waarvoor staan die afkorting EP in terme van smeerolie?

A 'External Pressure'
B 'Extreme Pressure'
C 'Excess Pressure'
D 'Extra Pressure' (1)

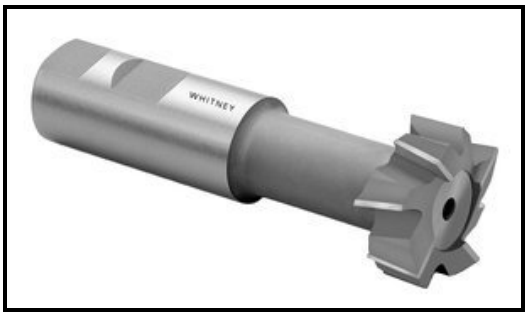
1.15 Wat is die doel van snyvloeistof?

A Dien as 'n nie-smeermiddel
B Laat snysels aan die snyer plak
C Verswak die gehalte van die afwerking
D Verkoel die snybeitel (1)

1.8 Wat is die voordeel van klimfreeswerk?

A Groter snydiepte word verkry.
B Die toevoer van die tafel moet stadiger wees.
C Die metode is onderhewig aan vibrasie.
D Dooiegang in die tafelvoerskroef moet uitgeskakel word. (1)

1.9 Identifiseer die freessnyer in FIGUUR 1.3 hieronder.



FIGUUR 1.3

A Swaelstertfrees
B Sy-en-vlakfrees
C T-gleuffrees
D Gelykhoekige frees (1)

1.10 Wat verstaan jy onder die *kerfbreektoets*?

A Die oopbreek van 'n sweislas om eksterne defekte te ondersoek
B Die ondersoek van skeurbreuke in 'n sweislas
C Die ondersoek van hoëfrekwensie-klankeffekte
D Die oopbreek van 'n sweislas om interne defekte te ondersoek (1)

1.11 Poreusheid van 'n sweislas verwys na …

A metaal wat in sweismetaal voorkom as gevolg van oppervlak-besmetting.
B gasporieë (prikgaatjies) in sweismetaal as gevolg van atmosferiese besmetting.
C kom as 'n opening aan die einde van 'n sweislas voor.
D kom as 'n opening aan die begin van 'n sweislas voor. (1)

1.12 Wat sal die geïnduseerde spanning wees indien 'n las van 50 N op 'n vierkantige staaf met 'n deursnee-oppervlakte van 144×10^{-6} m^2 toegepas word?

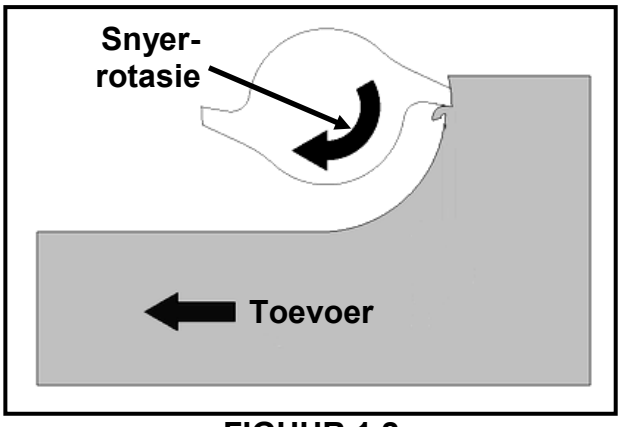
A 347 kPa
B 3,47 kPa
C 0,347 kPa
D 34,7 kPa (1)

1.6 Identifiseer die toerusting wat vir 'n toetsprosedure gebruik word in FIGUUR 1.1 hieronder.

FIGUUR 1.1

A Gasanalisator
B Veertoetser
C Brinell-hardheidstoetser
D Wringtoetser (1)

1.7 Identifiseer die freesproses in FIGUUR 1.2 hieronder.



FIGUUR 1.2

A Klimfreeswerk
B Opfreeswerk
C Koppelfreeswerk
D Vlakfreeswerk (1)

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie keuses word as moontlike antwoorde op die volgende vrae gegee. Kies die antwoord en skryf slegs die letter (A–D) langs die vraagnommer (1.1–1.20) in die ANTWOORDEBOEK neer, byvoorbeeld 1.21 D.

1.1 Watter EEN van die volgende handelinge word as gevaarlik beskou wanneer daar met 'n draaibank gewerk word?

A Dra oogbeskerming
B Dra korrekte klere
C Neem afmetings terwyl die werkstuk draai
D Werk op die draaibank met alle skerms in plek (1)

1.2 Watter EEN van die volgende veiligheidsmaatreëls is van toepassing op die MAGS/MIGS-sweisproses?

A Gaan die kleurkodes op silinders na.
B Hou die werkstuk in jou hand vas tydens die sweisproses.
C Draai die ontlasklep baie stadig.
D Maak seker die sweisarea is goed geventileerd. (1)

1.3 Watter gevorderde ingenieurstoerusting word gebruik om die hoeveelheid wring/verdraai-effek van 'n staaf te bepaal?

A Wringtoetser
B Brinell-toetser
C Trektoetser
D Veertoetser (1)

1.4 Koolstofstaal word volgens die persentasie koolstofinhoud klassifiseer. Hoëkoolstofstaal bevat minder as ... koolstof.

A 0,10%
B 0,30%
C 1,50%
D 0,60% (1)

1.5 ... word by staal gevoeg wanneer taaiheid, hardheid en slytasieweerstand verlang word.

A Brons
B Soldeersel
C Vanadium
D Lood (1)

INSTRUKSIES EN INLIGTING

1. Skryf jou sentrumnommer en eksamennommer in die spasies wat op die ANTWOORDEBOEK verskaf word.

2. Lees AL die vrae aandagtig deur.

3. Beantwoord AL die vrae.

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

5. Begin ELKE vraag op 'n NUWE bladsy.

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

7. Jy mag 'n nieprogrammeerbare/wetenskaplike sakrekenaar en teken-/ wiskundige instrumente gebruik.

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

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

10. Skryf netjies en leesbaar.

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

VRAAG	INHOUD	PUNTE	TYD
1	Meervoudigekeuse-vrae	20	18 minute
2	Gereedskap en toerusting	20	18 minute
3	Materiale	20	18 minute
4	Veiligheid, terminologie en hegtingsmetodes	50	45 minute
5	Instandhouding en turbines	40	36 minute
6	Kragte en 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 2014

PUNTE: 200

TYD: 3 uur

Hierdie vraestel bestaan uit 16 bladsye en 'n 5 bladsy-formuleblad.

* M C H T D M *

EASTERN CAPE