basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY

FEBRUARY/MARCH 2015

MARKS: 200

TIME: 3 hours

This question paper consists of 14 pages and a 4-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. A formula sheet appears at the end of the question paper.
12. Use the criteria below to assist you in managing your time.

QUESTION	CONTENT	MARKS	TIME
1	Multiple-choice questions	20	15 minutes
2	Safety	10	10 minutes
3	Tools and Equipment	12	10 minutes
4	Materials	13	10 minutes
5	Terminology	30	20 minutes
6	Joining Methods	25	25 minutes
7	Forces	30	30 minutes
8	Maintenance	15	15 minutes
9	Systems and Control	25	25 minutes
10	Turbines	20	20 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 A.

1.1 What safety precaution is applicable to the MIGS/MAGS welding process?

A Always use a striker to light the torch and not a match or lighter.
B The welder is completely insulated by means of boots and gloves.
C Open the cylinder valves quickly.
D Allow for oxygen and acetylene leaks. (1)

1.2 Which hardness tester uses a steel ball to determine the hardness of steel?

A Vickers tester
B Rockwell tester
C Victor tester
D Brinell tester (1)

1.3 The gas analyser is used during the fuel mixture setting of a motor-car engine. Which ONE of the following is the CORRECT reason for a high carbon-monoxide reading?

A Low compression
B Worn valves
C A clogged air filter
D Worn piston rings (1)

1.4 The function of the tensile tester:

A To determine the compressive stress and ultimate pushing stress on a piece of a material
B To demonstrate a pulling stress on a supported beam
C To demonstrate the deflection of a simply supported beam
D To determine yield stress, ultimate pulling stress and percentage of elongation on a piece of material (1)

1.5 When carbon steel is heated at a uniform rate, the temperature rises evenly to 700 °C. The temperature then remains constant for a while. This point is known as the … point.

A decalescent
B melting
C lower critical
D heating (1)

1.6 Steel can be hardened and annealed at a temperature between 885 °C and 925 °C. What percentage carbon content will allow for this hardening and annealing? Use the iron carbon equilibrium diagram in FIGURE 1.1 below.

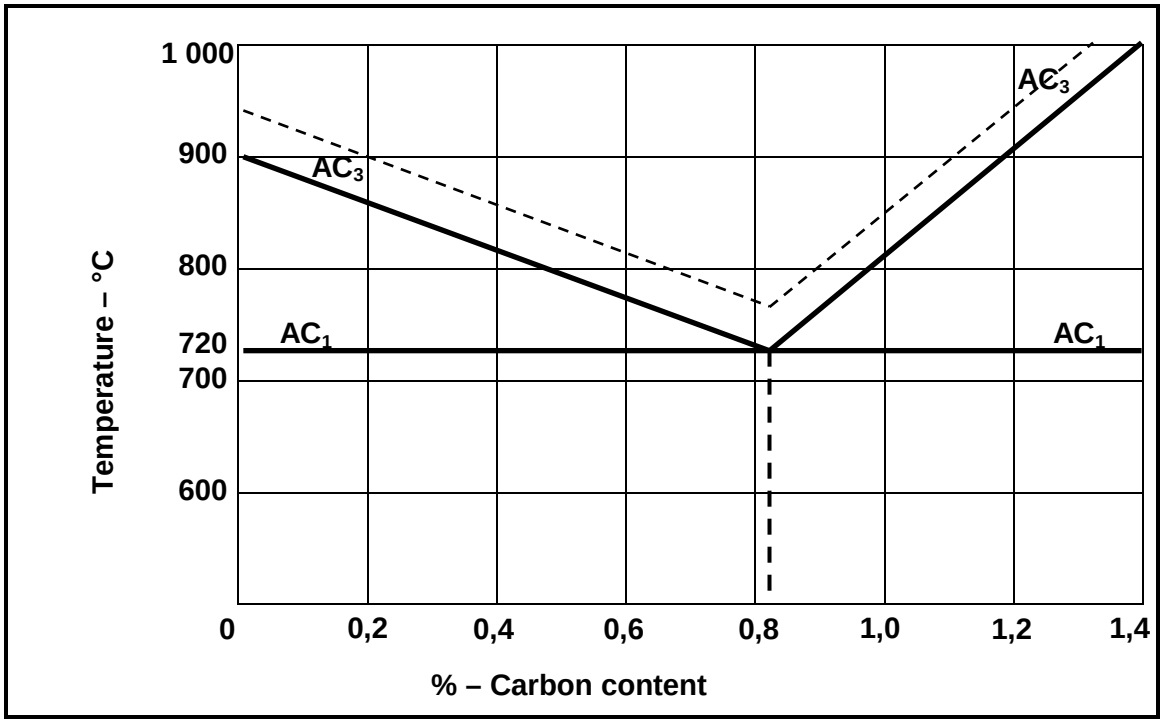


FIGURE 1.1

A 0,60%
B 0,20%
C 0,80%
D 0,40% (1)

1.7 Name the tool that is used to set the cutting tool perpendicular to the axis of the work piece when cutting a screw thread on the lathe:

A Screw-pitch gauge
B Screw-thread ring gauge
C Centre gauge
D Screw gauge (1)

1.8 What is the standard ratio of a taper key?

A 1 in 50
B 1 in 100
C 1 in 150
D 1 in 75 (1)

1.9 What defect appears as a groove in the parent metal, directly along the edges of the weld?

A Undercutting
B Slag inclusion
C Porosity
D Incomplete penetration (1)

1.10 Which ONE of the following is an example of a destructive test?

A X-ray test
B Liquid dye penetration test
C Ultrasonic test
D Bend test (1)

1.11 Compressive stress can be defined as an internal force in material that provides resistance against a … load.

A shearing
B tensile
C compressive
D linear (1)

1.12 Which ONE of the following statements describes Pascal's law?

A The area is inversely proportional to the pressure on it if the temperature remains constant.
B The pressure exerted on the surface of the liquid in a closed hydraulic system is transmitted equally in all directions.
C The pressure is proportional to the volume if the temperature remains constant.
D The volume is inversely proportional to the pressure on it if the temperature increases. (1)

1.13 The following statement describes an advantage of a belt-drive system compared to a gear-drive system:

A Stronger
B Needs no lubrication
C Changes direction
D More durable (1)

1.14 Calculate the strain when a tensile force causes a stress of 6 MPa in a work piece. The material has an elasticity module of 3 GPa:

A 2×10^{3}
B 500
C $1{,}8 \times 10^{9}$
D 2×10^{-3} (1)

1.15 What is the composition of cutting fluid?

A Soluble oil and water
B Grease and water
C Engine oil and water
D Machine oil and water (1)

1.16 What does the abbreviation ECU stand for in terms of the vehicle management system?

A Economical control unit
B Electronic control unit
C Electricity control unit
D Engine control unit (1)

1.17 How is the supercharger driven?

A Hydraulically driven
B Gas driven
C Pneumatically driven
D Mechanically driven (1)

1.18 During a gas turbine application the auxiliary power unit is described as … gas turbine designed for auxiliary power.

A a large
B a medium
C a larger
D a small (1)

1.19 Force is a vector unit which is recognised by …

A magnitude only.
B direction only.
C magnitude and direction.
D volume and direction. (1)

1.20 What does point **D** denote in FIGURE 1.2 below?

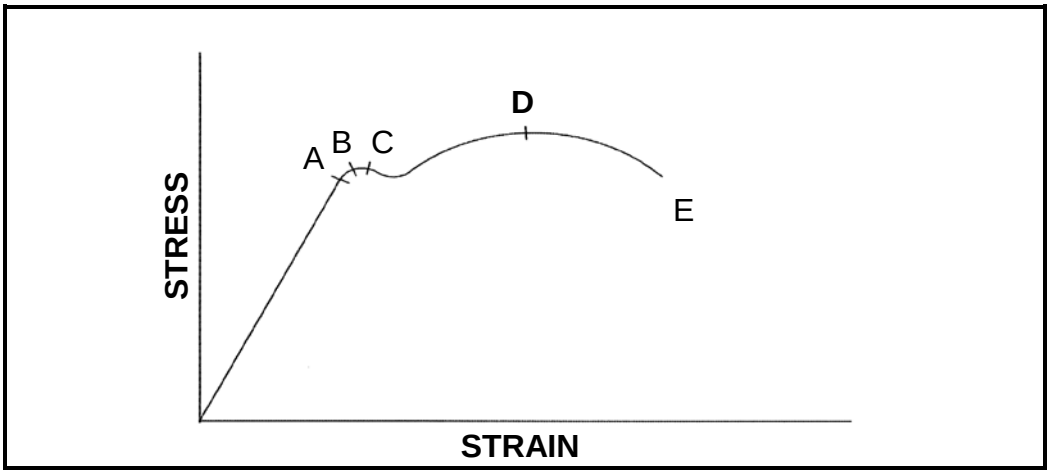


FIGURE 1.2

A Limit of proportionality
B Maximum strain
C Maximum stress
D Limit of elasticity (1)

[20]

QUESTION 2: SAFETY

2.1 All personal and environmental safety rules have already been taken care of when a surface grinder is used. State THREE safety rules which are only applicable while the surface grinder is being used. (3)

2.2 Give TWO reasons why the pressure gauge of a hydraulic press must be tested regularly. (2)

2.3 Why is it important to keep the copper tips of the spot welder constantly cool during use? (1)

2.4 Describe the position of the following regarding the cylinder leakage test:

2.4.1 Stroke (1)
2.4.2 Piston (1)
2.4.3 Valves (1)

2.5 At what angle to the bearing should a bearing puller be used? (1)
[10]

QUESTION 3: TOOLS AND EQUIPMENT

3.1 Explain how a voltmeter and an ammeter are connected to a circuit. (2)

3.2 Describe the purpose of the following tests:

3.2.1 Beam-bending test (2)
3.2.2 Cylinder-leakage test (2)

3.3 When Johnny conducted a dry compression test, the test indicated that the first cylinder had a very low reading. After conducting a wet test, the reading was higher. To what conclusion can Johnny come about the test? (2)

3.4 FIGURE 3.1 below shows a compression tester that is used to check the compression of a cylinder. Label parts **A**–**D**.

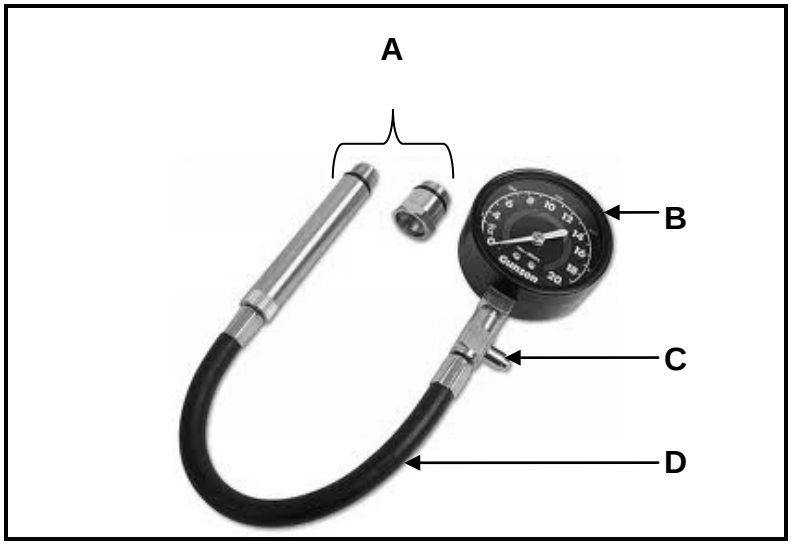


FIGURE 3.1 (4)
[12]

QUESTION 4: MATERIALS

4.1 Name TWO characteristics of each of the following microscopic structures of steel:

4.1.1 Ferrite (2)
4.1.2 Pearlite (2)

4.2 Determine the microscopic structure that best describes the compound of iron and carbon (iron carbide) by analysing steel and cast iron. (2)

4.3 The table below indicates the carbon content, typical uses, heat treatment and properties of steel. Write your answers for QUESTIONS 4.3.1, 4.3.2 and 4.3.3 in the ANSWER BOOK.

CARBON CONTENT	TYPICAL USES	HEAT TREATMENT	PROPERTIES
Low 0,1–0,25%	**4.3.1**	Annealing	Strong; durable
Medium 0,25–0,55%	Crankshafts; pliers; screwdrivers	**4.3.2**	Tough; hard surface
High 0,55–1,00%	Cutting tools; springs; hammers	Hardening	**4.3.3**

(3)

4.4 Define the terms below with reference to the iron-carbon equilibrium diagram:

4.4.1 Lower critical point (AC_1) (2)

4.4.2 Critical temperature (2)

[13]

QUESTION 5: TERMINOLOGY

5.1 Explain step by step how a metric V-screw thread with a pitch of 1,5 mm is cut on the centre lathe. (11)

5.2 Calculate the cutting depth of a metric V-screw thread with a pitch of 2,5 mm using the compound slide method. (3)

5.3 Calculate the simple indexing needed to cut a gear with 82 teeth. (3)

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

5.4.1 The diameter of the shaft (3)

5.4.2 The width of the key (3)

5.4.3 The thickness of the key (3)

5.5 Show, by means of neat labelled sketches, the difference between *upcut milling* and *downcut milling*. (4)

[30]

QUESTION 6: JOINING METHODS

6.1 FIGURE 6.1 shows a welding machine with different attachments.

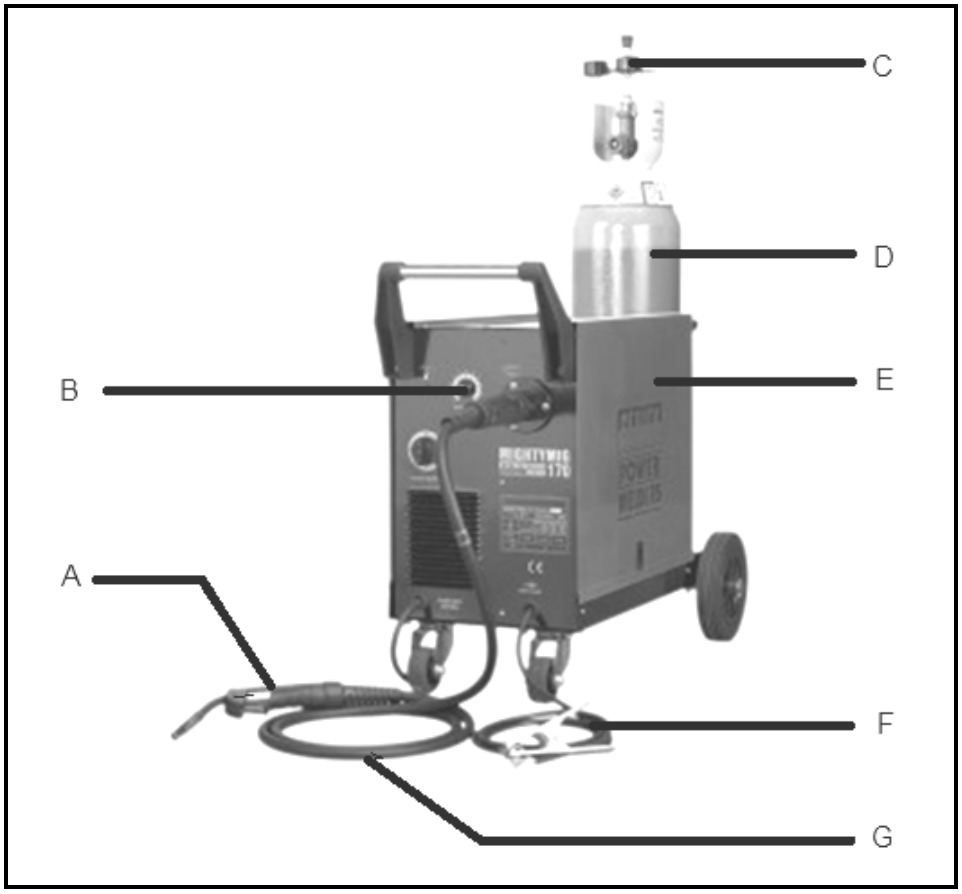


FIGURE 6.1

6.1.1 Identify the welding machine in FIGURE 6.1. (1)

6.1.2 Label parts **A**–**G** in FIGURE 6.1. (7)

6.2 Explain the operating principle of the X-ray testing equipment as applicable to a welded joint. (6)

6.3 State THREE advantages of metal-arc shielded welding (MIGS/MAGS). (3)

6.4 What is the purpose of a bend test? (2)

6.5 State TWO causes of the following welding defects:

6.5.1 Incomplete penetration (2)

6.5.2 Welding craters (2)

6.6 Which TWO aspects regarding welding techniques should be kept in mind during arc welding? (2)

[25]

QUESTION 7: FORCES

7.1 Four forces of 150 N, 210 N, 250 N and 360 N respectively, as shown in FIGURE 7.1 below, act on the same point. Calculate the magnitude and direction of the equilibrant for this system of forces.

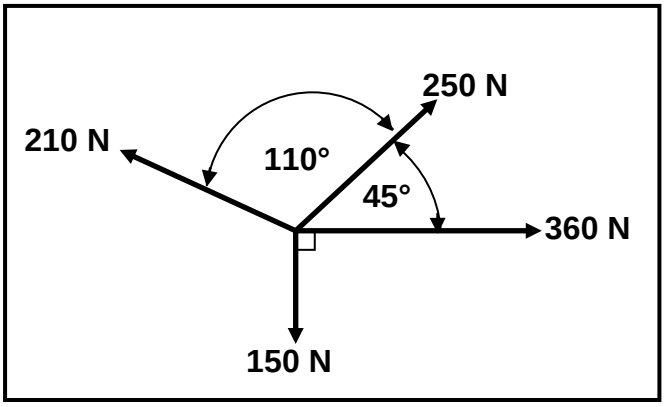


FIGURE 7.1 (15)

7.2 A square steel bar with 100 mm x 100 mm sides is subjected to a compressive force of 80 kN. Determine, by means of calculations, the stress in the material. (5)

7.3 Define *Hooke's law*. (3)

7.4 FIGURE 7.2 below shows a uniform beam that is supported by two vertical supports, **A** and **B**. Two vertical point loads are exerted onto the beam, as well as a uniformly distributed load of 50 N/m, over the total left half of the beam.

Determine, by means of calculations, the magnitudes of the reactions in supports **A** and **B**.

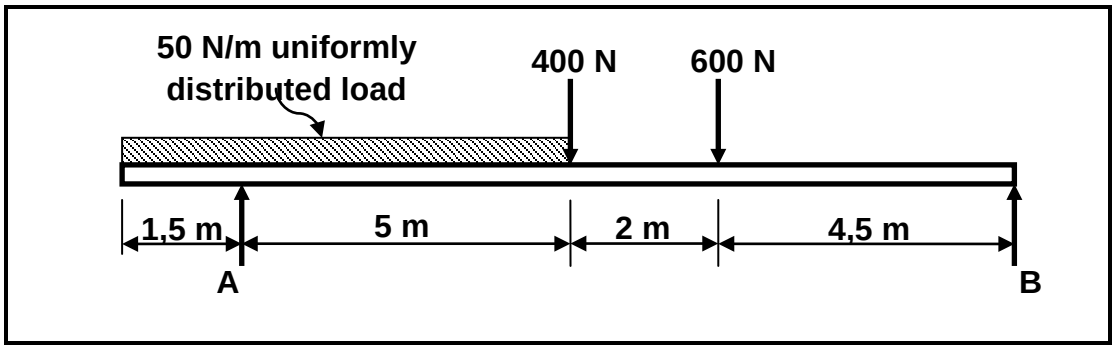


FIGURE 7.2 (7)

[30]

QUESTION 8: MAINTENANCE

8.1 State TWO advantages of a cutting fluid. (2)

8.2 Define *preventive maintenance.* (1)

8.3 Car manufacturers recommend that the timing chain of a car engine be replaced every 90 000 km. Answer the questions that follow.

8.3.1 Give TWO reasons why a chain drive is preferred to a belt drive. (2)

8.3.2 Give TWO reasons why a stretched chain has to be replaced. (2)

8.3.3 Explain in point form how you would remove and replace the timing chain of an engine. (6)

8.4 Why is it desirable for engine oil to have a high flash point? (2)
[15]

QUESTION 9: SYSTEMS AND CONTROL

9.1 FIGURE 9.1 below shows a gear system used to control a hoisting machine. The driver gear has 50 teeth and rotates at 660 r/min. The idler gear that is used to change the direction, rotates at 1 000 r/min. The driven gear has 60 teeth.

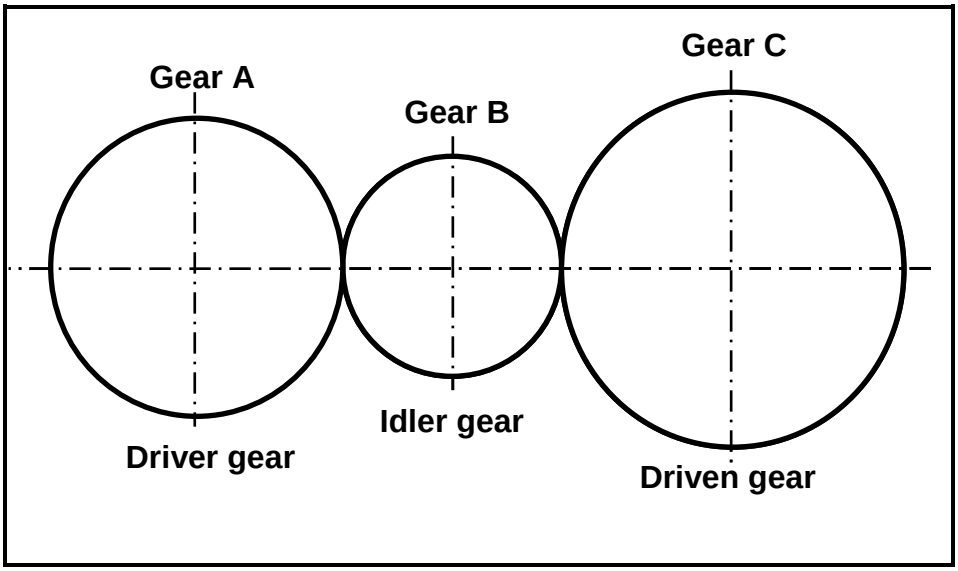


FIGURE 9.1

Determine by means of calculations:

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

9.1.2 The rotation frequency of the driven gear in revolutions per second (3)

9.2 The drive pulley of a belt-drive system rotates at 1 640 r/min. The drive pulley has a diameter of 175 mm and the driven pulley a diameter of 80 mm. The belt thickness is 12 mm.

Take the belt thickness into consideration and determine, by means of calculations:

9.2.1 The rotation frequency of the driven pulley in revolutions per second (3)

9.2.2 The belt speed of the system (3)

9.3 A hydraulic system is used to compress scrap metal for recycling. The specifications of the system are presented diagrammatically in FIGURE 9.2.

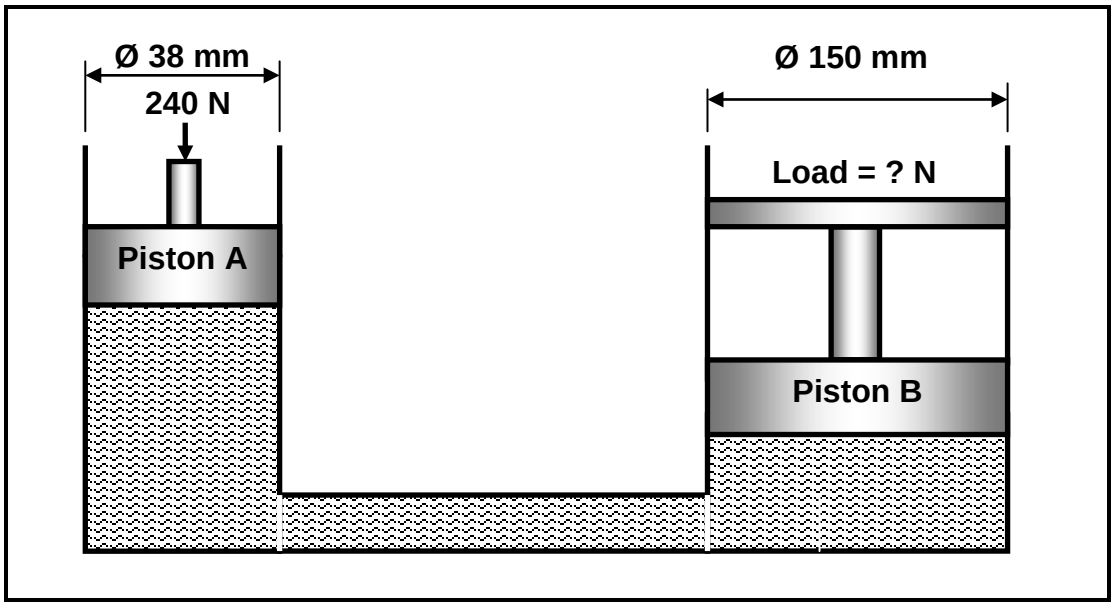


FIGURE 9.2

Determine, by means of calculations:

9.3.1 The fluid pressure in the hydraulic system while in equilibrium (3)

9.3.2 The force exerted by piston **B** (4)

9.4 Describe the purpose of the vehicle-engine management system. (4)

9.5 Describe the purpose of the anti-lock brake system (ABS). (2)
[25]

QUESTION 10: TURBINES

10.1 State TWO positive impacts a water turbine will have on the environment and society. (2)

10.2 Define the following terms regarding a water turbine:

10.2.1 Specific speed (2)

10.2.2 Free load speed/Runaway speed (2)

10.3 State the function of a steam turbine. (2)

10.4 Name THREE types of steam turbines. (3)

10.5 What is the advantage of using gas turbines on naval vessels? (2)

10.6 Define *turbo boost.* (2)

10.7 Explain in point form the operation of a twin-screw supercharger. (5)
[20]

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 $N_1D_1 = N_2D_2$

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

$T_2 =$ force in the 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 $Area_{round\ bar} = \frac{\pi D^2}{4}$ and $Area_{round\ tube} = \frac{\pi\left(D^2 - d^2\right)}{4}$

$Area_{square\ bar} = L^2$ and $Area_{sqaure\ tube} = L^2 - l^2$

4. HYDRAULICS

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

4.2 *Volume = cross-sectional area × stroke length (l or s)*

4.3 *Work done = force × distance*

4.4 $Area = \frac{\pi D^2}{4}$

4.5 $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

5. GEAR DRIVES

5.1 $Power\ (P) = \frac{2\pi N T}{60}$

5.2 $Gear\ ratio = \frac{product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

5.3 $\frac{N_{input}}{N_{output}} = \frac{product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

5.4 *Torque = force × radius*

5.5 *Torque transmitted = gear ratio × input torque*

5.6 $Module\ (m) = \frac{pitch\text{-}circle\ diameter\ (PCD)}{number\ of\ teeth\ (T)}$

5.7 $N_1T_1 = N_2T_2$

5.8 $Pitch\text{-}circle\ diameter\ (PCD) = \frac{circular\ pitch\ (CP) \times number\ of\ teeth\ (T)}{\pi}$

5.9 $Outside\ diameter\ (OD) = PCD + 2\ module$

5.10 $Addendum\ (a) = module\ (m)$

5.11 $Dedendum\ (b) = 1{,}157\ m$ or $Dedendum\ (b) = 1{,}25\ m$

5.12 $Cutting\ depth\ (h) = 2{,}157\ m$ or $Cutting\ depth\ (h) = 2{,}25\ m$

5.13 $Clearance\ (c) = 0{,}157\ m$ or $Clearance\ (c) = 0{,}25\ m$

5.14 $Circular\ pitch\ (CP) = m \times \pi$

6. PULLEY DRIVES

6.1 $N_1D_1 = N_2D_2$

6.2 $Power\ (P) = \frac{2\pi NT}{60}$

6.3 $Velocity\ Ratio = \frac{diameter\ of\ driven\ pulley}{diameter\ of\ driver\ pulley}$

7. KEYWAYS

7.1 $Width\ of\ key = \frac{diameter\ of\ shaft}{4}$

7.2 $Thickness\ of\ key = \frac{diameter\ of\ shaft}{6}$

7.3 $Length\ of\ the\ key = 1{,}5 \times diameter\ of\ shaft$

7.4 $Taper\ of\ key = 1 : 100$

8. LEVERS

8.1 $Mechanical\ advantage\ (MA) = \frac{load\ (W)}{effort\ (F)}$

8.2 $Input\ movement\ (IM) = effort \times distance\ moved\ by\ effort$

8.3 $Output\ movement\ (OM) = load \times distance\ moved\ by\ load$

8.4 $Velocity\ ratio\ (VR) = \frac{input\ movement}{output\ movement}$

9. SCREW THREADS

9.1 $Pitch\ diameter = outside\ diameter - ½\ pitch$

9.2 $Pitch\ circumference = \pi \times pitch\ diameter$

9.3 $Lead = pitch \times number\ of\ starts$

9.4 $Height\ of\ screw\ thread = 0{,}866 \times pitch\ (P)$

9.5 $Depth\ of\ screw\ thread = 0{,}613 \times pitch\ (P)$

9.6 $Number\ of\ turns = \frac{height}{lead}$

10. INDEXING

CINCINNATI DIVIDING HEAD TABLE FOR HOLE CIRCLES IN PLATE

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*

$Indexing = \frac{40}{n}$

8. HEFBOME

8.1 $Meganiese\ voordeel\ (\ MA\ ) = \dfrac{las\ (\ W\ )}{hyskrag\ (\ F\ )}$

8.2 $Insetbeweging\ (\ IM\ ) = hyskrag \times afstand\ beweeg\ deur\ hyskrag$

8.3 $Uitsetbeweging\ (\ OM\ ) = las \times afstand\ beweeg\ deur\ las$

8.4 $Snelheidsverhouding\ (\ VR\ ) = \dfrac{insetbeweging}{uitsetbeweging}$

9. SKROEFDRAAD

9.1 $Steekdiameter = buitediameter - ½\ steek$

9.2 $Steekomtrek = \pi \times steekdiameter$

9.3 $Styging = steek \times getal\ beginne$

9.4 $Hoogte\ \ van\ \ skroefdraad = 0{,}866\ \times\ steek\,(P)$

9.5 $Diepte\ \ van\ \ skroefdraad = 0{,}613\ \times\ steek\,(P)$

9.6 $Getal\ draaie = \dfrac{hoogte}{styging}$

10. INDEKSERING

CINCINNATI-VERDEELKOPTABEL VIR GATSIRKELS IN PLAAT

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

$Indeksering = \dfrac{40}{n}$

5.6 $Module\,(\,m\,) = \dfrac{Steeksirkeldiameter\,(\,SSD\,)}{Getal\ tande\,(\,T\,)}$

5.7 $N_1T_1 = N_2T_2$

5.8 $Steeksirkeldiameter\,(\,SSD\,) = \dfrac{sirkelsteek\,(\,SS\,) \times getal\ tande\,(\,T\,)}{\pi}$

5.9 $Buitediameter\,(\,BD\,) = SSD + 2\ module$

5.10 $Addendum\,(\,a\,) = module\,(\,m\,)$

5.11 $Dedendum\,(\,b\,) = 1{,}157\ m$ *of* $Dedendum\,(\,b\,) = 1{,}25\ m$

5.12 $Snydiepte\,(\,h\,) = 2{,}157\ m$ *of* $Snydiepte\,(\,h\,) = 2{,}25\ m$

5.13 $Vry\ ruimte\,(\,c\,) = 0{,}157\ m$ *of* $Vry\ ruimte\,(\,c\,) = 0{,}25\ m$

5.14 $Sirkelsteek\,(\,SS\,) = m \times \pi$

6. KATROLAANDRYWINGS

6.1 $N_1D_1 = N_2D_2$

6.2 $Drywing\,(\,P\,) = \dfrac{2\pi NT}{60}$

6.3 $Spoedverhouding\ = \dfrac{diameter\ van\ gedrewe\ katrol}{diameter\ van\ dryfkatrol}$

7. SPYE

7.1 $Wydte\ \ van\ \ spy = \dfrac{diameter\ \ van\ \ as}{4}$

7.2 $Dikte\ \ van\ \ spy = \dfrac{diameter\ \ van\ \ as}{6}$

7.3 $Lengte\ \ van\ \ spy = 1{,}5 \times diameter\ \ van\ \ as$

7.4 $Tapsheid\ \ van\ \ spy = 1 : 100$

3. SPANNING EN VORMVERANDERING

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

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

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

3.4 $Oppervlakte_{ronde\ staaf} = \frac{\pi D^2}{4}$ *en* $Oppervlakte_{ronde\ pyp} = \frac{\pi\left(D^2 - d^2\right)}{4}$

$Oppervlakte_{vierkantige\ staaf} = L^2$ *en* $Oppervlakte_{vierkantige\ pyp} = L^2 - l^2$

4. HIDROULIKA

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

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

4.3 *Arbeid verrig = krag × afstand*

4.4 $Oppervlakte = \frac{\pi D^2}{4}$

4.5 $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

5. RATAANDRYWINGS

5.1 $Drywing\ (P) = \frac{2\pi NT}{60}$

5.2 $Ratverhouding = \frac{produk\ van\ die\ getal\ tande\ op\ gedrewe\ ratte}{produk\ van\ die\ getal\ tande\ op\ dryfratte}$

5.3 $\frac{N_{inset}}{N_{uitset}} = \frac{produk\ van\ die\ getal\ tande\ op\ gedrewe\ ratte}{produk\ van\ die\ getal\ tande\ op\ dryfratte}$

5.4 $Wringkrag = krag \times radius$

5.5 $Wringkrag\ oorgedra = ratverhouding \times insetwringkrag$

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

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

1.5 $N_1 D_1 = N_2 D_2$

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

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

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

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

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

2. WRYWINGKOPPELAARS

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

waar μ = wrywingskoëffisiënt

W = totale druk

n = getal wrywingsoppervlakke

R = effektiewe radius

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

VRAAG 10: TURBINES

10.1 Noem TWEE positiewe invloede wat 'n waterturbine op die omgewing en die samelewing sal hê. (2)

10.2 Definieer die volgende terme rakende 'n waterturbine:

10.2.1 Soortlike spoed (2)

10.2.2 Vryloopspoed (2)

10.3 Noem die funksie van 'n stoomturbine. (2)

10.4 Noem DRIE tipes stoomturbines. (3)

10.5 Wat is die voordeel van die gebruik van gasturbines op vlootvaartuie? (2)

10.6 Definieer *aanjagingsdruk.* (2)

10.7 Verduidelik puntsgewys die werking van 'n dubbelskroef-drukaanjaer ('supercharger') (5)
[20]

TOTAAL: 200

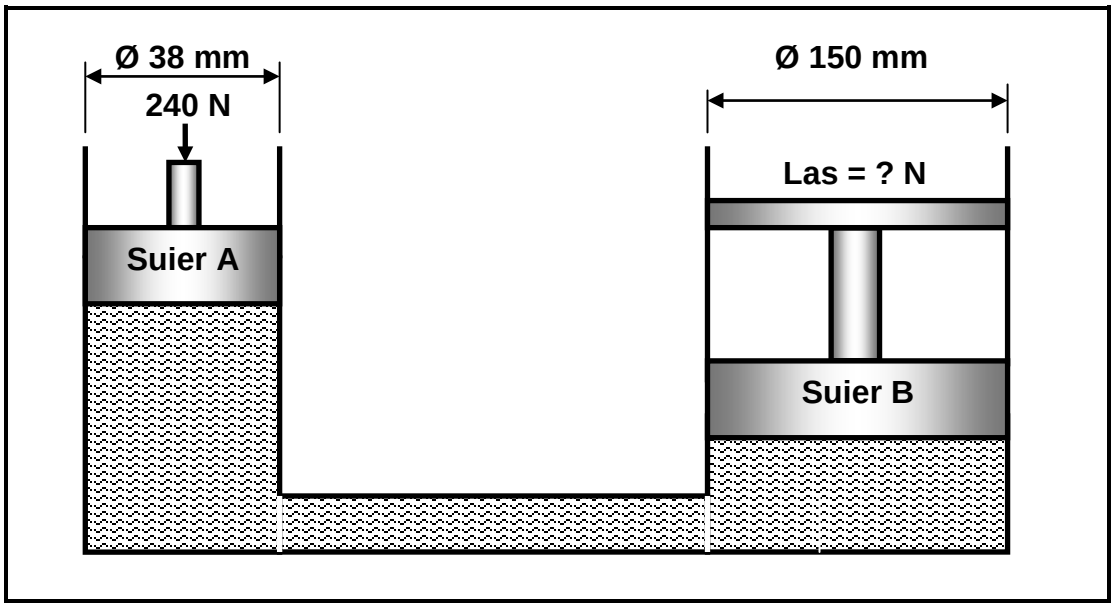
9.2 Die dryfkatrol van 'n bandaandrywingstelsel roteer teen 1 640 r/min. Die dryfkatrol het 'n diameter van 175 mm en die gedrewe katrol se diameter is 80 mm. Die banddikte is 12 mm.

Neem die banddikte in aanmerking en bepaal, deur middel van berekeninge:

9.2.1 Die rotasiefrekwensie van die gedrewe katrol in revolusies per sekonde (3)

9.2.2 Die bandspoed van die stelsel (3)

9.3 'n Hidrouliese stelsel word gebruik om skrootmetaal vir herwinning saam te pers. Die spesifikasies van die stelsel word diagrammaties in FIGUUR 9.2 hieronder voorgestel.



FIGUUR 9.2

Bepaal, deur middel van berekeninge:

9.3.1 Die vloeistofdruk in die hidrouliese stelsel wanneer dit in ewewig is (3)

9.3.2 Die krag uitgeoefen deur suier **B** (4)

9.4 Beskryf die doel van die voertuigenjin-beheerstelsel. (4)

9.5 Beskryf die doel van die sluitweerremstelsel (ABS). (2)
[25]

VRAAG 8: INSTANDHOUDING

8.1 Noem TWEE voordele van 'n snyvloeistof. (2)

8.2 Definieer *voorkomende instandhouding.* (1)

8.3 Motorvervaardigers beveel aan dat die tydreëlketting van 'n voertuigenjin elke 90 000 km vervang moet word. Beantwoord die vrae wat volg.

8.3.1 Gee TWEE redes waarom 'n kettingaandrywing bo 'n band-aandrywing verkies word. (2)

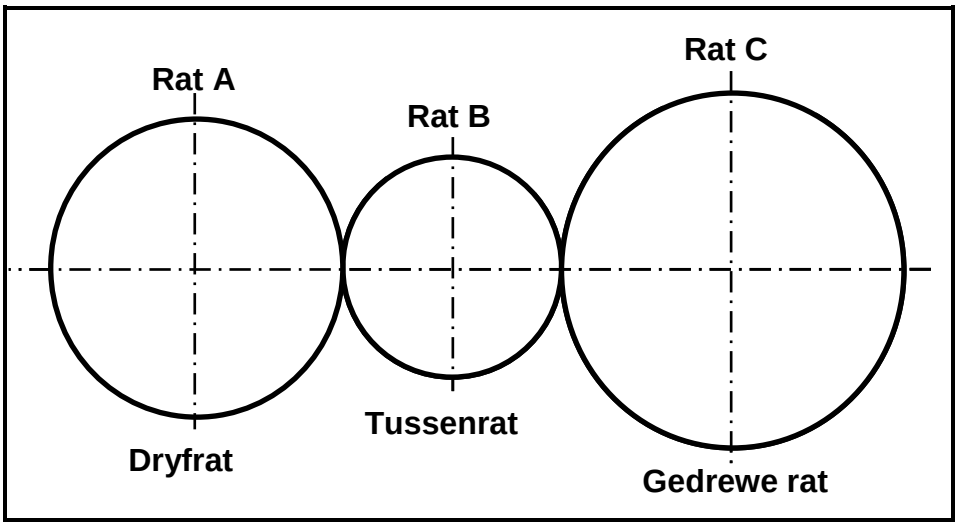
8.3.2 Gee TWEE redes waarom 'n gerekte ketting vervang moet word. (2)

8.3.3 Verduidelik puntsgewys hoe jy die tydreëlketting van 'n enjin sal verwyder en vervang. (6)

8.4 Waarom is dit wenslik dat enjinolie 'n hoë flitspunt moet hê? (2)
[15]

VRAAG 9: STELSELS EN BEHEER

9.1 FIGUUR 9.1 hieronder toon 'n ratstelsel wat gebruik word om 'n hysmasjien te beheer. Die dryfrat het 50 tande en roteer teen 660 r/min. Die tussenrat wat gebruik word om die draairigting te verander, draai teen 1 000 r/min. Die gedrewe rat het 60 tande.



FIGUUR 9.1

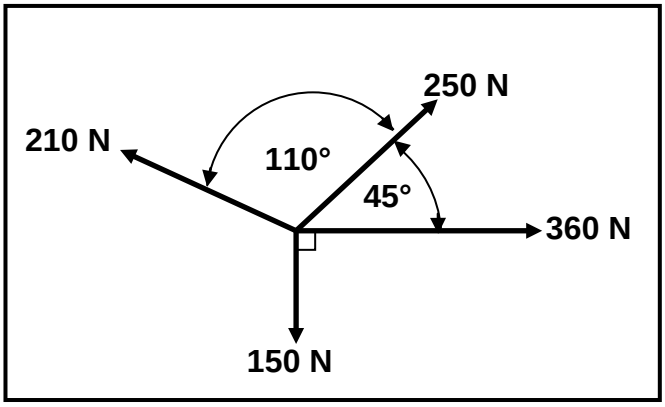
Bepaal, deur middel van berekeninge:

9.1.1 Die getal tande van die tussenrat (3)

9.1.2 Die rotasiefrekwensie van die gedrewe rat in omwentelinge per sekonde (3)

VRAAG 7: KRAGTE

7.1 Vier kragte van 150 N, 210 N, 250 N en 360 N onderskeidelik, soos getoon in FIGUUR 7.1 hieronder, werk op dieselfde punt in. Bereken die grootte en die rigting van die ewewigskrag vir hierdie stelsel van kragte.



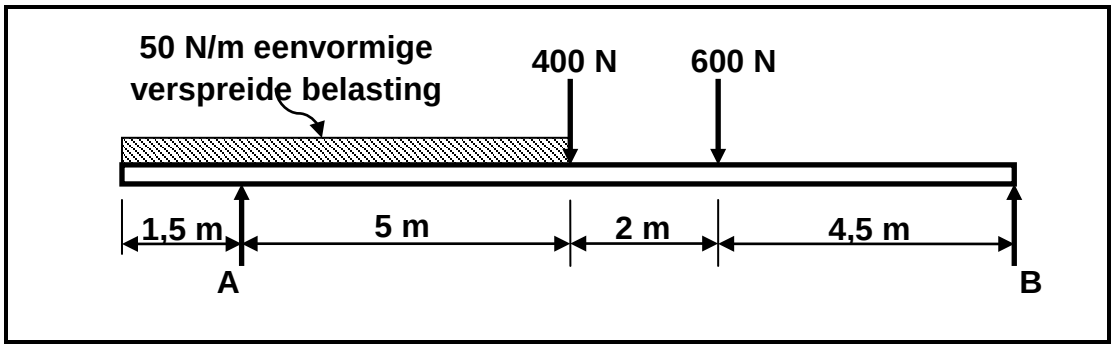
FIGUUR 7.1 (15)

7.2 'n Vierkantige staalstaaf, met 100 mm x 100 mm-sye, word aan 'n drukkrag van 80 kN onderwerp. Bepaal, deur middel van berekeninge, die spanning in die materiaal. (5)

7.3 Definieer *Hooke se wet*. (3)

7.4 FIGUUR 7.2 hieronder toon 'n eenvormige balk wat deur twee vertikale stutte, **A** en **B**, ondersteun word. Twee vertikale puntbelastings word op die balk uitgeoefen, asook 'n eenvormige verspreide belasting van 50 N/m, oor die hele linkerhelfte van die balk.

Bepaal, deur middel van berekeninge, die groottes van die reaksies in stut **A** en **B**.

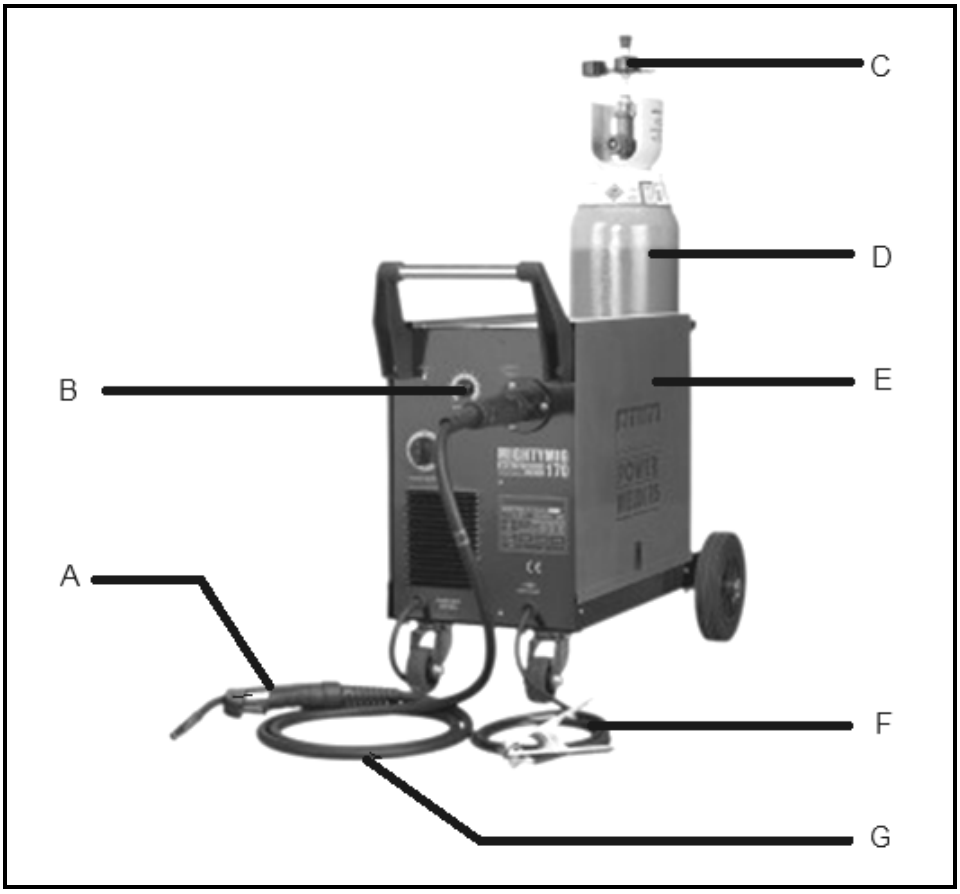


FIGUUR 7.2 (7)

[30]

VRAAG 6: HEGTINGSMETODES

6.1 FIGUUR 6.1 toon 'n sweismasjien met verskillende toebehore.



FIGUUR 6.1

6.1.1 Identifiseer die sweismasjien in FIGUUR 6.1. (1)

6.1.2 Benoem onderdeel **A**–**G** in FIGUUR 6.1. (7)

6.2 Verduidelik die werkbeginsel van die X-straaltoetstoerusting soos van toepassing op 'n sweislas. (6)

6.3 Noem DRIE voordele van afgeskermde metaalboogsweiswerk (MIGS/MAGS). (3)

6.4 Wat is die doel van 'n buigtoets? (2)

6.5 Noem TWEE oorsake van die volgende sweisdefekte:

6.5.1 Onvolledige indringing (2)

6.5.2 Sweiskraters (2)

6.6 Watter TWEE aspekte met betrekking tot sweistegnieke moet tydens boogsweis in gedagte gehou word? (2)

[25]

VRAAG 4: MATERIALE

4.1 Noem TWEE eienskappe van elk van die volgende mikroskopiese strukture van staal:

4.1.1 Ferriet (2)
4.1.2 Perliet (2)

4.2 Bepaal die mikroskopiese struktuur wat die samestelling van yster en koolstof (ysterkarbied) deur die analise van staal en gietyster die beste beskryf. (2)

4.3 Die tabel hieronder dui die koolstofinhoud, tipiese gebruike, hitte-behandeling en eienskappe van staal aan. Skryf die antwoord op VRAAG 4.3.1, 4.3.2 en 4.3.3 in die ANTWOORDEBOEK neer.

KOOLSTOF-INHOUD	TIPIESE GEBRUIKE	HITTE-BEHANDELING	EIENSKAPPE
Laag 0,1–0,25%	**4.3.1**	Uitgloeiing	Sterk; duursaam
Medium 0,25–0,55%	Krukas; tange; skroewedraaiers	**4.3.2**	Taai; harde oppervlak
Hoog 0,55–1,00%	Snygereedskap; vere; hamers	Verharding	**4.3.3**

(3)

4.4 Definieer die volgende terme met verwysing na die yster-koolstof-ewewigsdiagram:

4.4.1 Laer kritieke punt (AC_1) (2)

4.4.2 Kritieke temperatuur (2)

[13]

VRAAG 5: TERMINOLOGIE

5.1 Verduidelik stapsgewys hoe 'n metrieke V-skroefdraad met 'n steek van 1,5 mm op 'n senterdraaibank gesny word. (11)

5.2 Bereken die snydiepte van 'n metrieke V-skroefdraad met 'n steek van 2,5 mm wanneer die saamgestelde-beitelslee-metode gebruik word. (3)

5.3 Bereken die eenvoudige indeksering wat nodig is om 'n rat met 82 tande te sny. (3)

5.4 Die lengte van 'n parallelspy is 102 mm. Bereken:

5.4.1 Die diameter van die as (3)

5.4.2 Die wydte van die spy (3)

5.4.3 Die dikte van die spy (3)

5.5 Toon, met behulp van netjiese benoemde sketse, die verskil tussen *opfreeswerk* en *klimfreeswerk* aan. (4)

[30]

VRAAG 2: VEILIGHEID

2.1 Alle persoonlike- en omgewingsveiligheidsmaatreëls is reeds nagekom wanneer 'n vlakslyper gebruik word. Noem DRIE veiligheidsmaatreëls wat slegs van toepassing is terwyl die vlakslyper gebruik word. (3)

2.2 Gee TWEE redes waarom die drukmeter van 'n hidrouliese pers gereeld getoets moet word. (2)

2.3 Hoekom is dit belangrik dat die koperpunte van die puntsweiser tydens gebruik konstant koel gehou moet word? (1)

2.4 Beskryf die posisie van die volgende met betrekking tot die silinderlekkasietoets:

2.4.1 Slag (1)
2.4.2 Suier (1)
2.4.3 Kleppe (1)

2.5 Teen watter hoek tot die laer moet 'n laertrekker gebruik word? (1)
[10]

VRAAG 3: GEREEDSKAP EN TOERUSTING

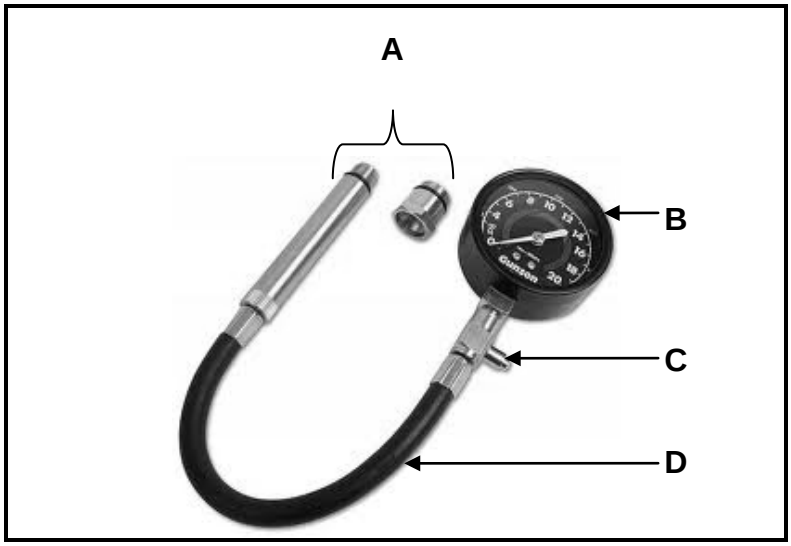
3.1 Verduidelik hoe 'n voltmeter en 'n ammeter aan 'n stroombaan gekoppel word. (2)

3.2 Beskryf die doel van die volgende toetse:

3.2.1 Balkbuigtoets (2)
3.2.2 Silinderlekkasietoets (2)

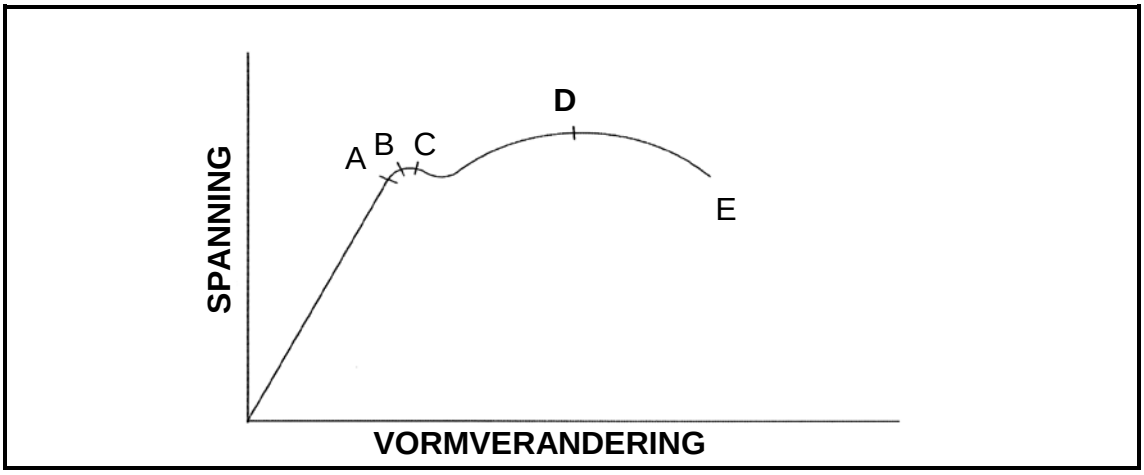
3.3 Toe Johnny 'n droë kompressietoets uitgevoer het, het die toets getoon dat die eerste silinder 'n baie lae lesing het. Nadat 'n nat toets uitgevoer is, was die lesing hoër. Watter afleiding kan Johnny uit die toets maak? (2)

3.4 FIGUUR 3.1 hieronder toon 'n kompressietoetser wat gebruik word om die druk van 'n silinder te toets. Benoem onderdeel **A**–**D**.



FIGUUR 3.1 (4)
[12]

1.20 Wat stel punt **D** in FIGUUR 1.2 voor?



FIGUUR 1.2

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

[20]

1.14 Bereken die vormverandering wanneer 'n trekkrag 'n spanning van 6 MPa in 'n werkstuk veroorsaak. Die materiaal het 'n elastisiteitsmodule van 3 GPa:

A 2×10^{3}
B 500
C $1{,}8 \times 10^{9}$
D 2×10^{-3} (1)

1.15 Wat is die samestelling van snyvloeistof?

A Oplosbare olie en water
B Ghries en water
C Enjinolie en water
D Masjienolie en water (1)

1.16 Waarvoor staan die afkorting EBE ('ECU') by voertuigbeheerstelsels?

A Ekonomiese beheereenheid
B Elektroniese beheereenheid
C Elektriese beheereenheid
D Enjinbeheereenheid (1)

1.17 Hoe word die superaanjaer aangedryf?

A Hidrouliese aandrywing
B Gasaandrywing
C Pneumatiese aandrywing
D Meganiese aandrywing (1)

1.18 Tydens 'n gasturbinetoepassing word die hulpkrageenheid beskryf as 'n … gasturbine ontwerp vir hulpkrag.

A groot
B mediumgrootte
C groter
D klein (1)

1.19 Krag is 'n vektoreenheid wat deur … gekenmerk word.

A slegs grootte
B slegs rigting
C grootte en rigting
D volume en rigting (1)

1.9 Watter defek kom as 'n groef direk langs die rande van 'n sweislas in die moeder-/basismetaal voor?

A Insnyding
B Slakinsluiting
C Poreusheid
D Onvolledige indringing (1)

1.10 Watter EEN van die volgende is 'n voorbeeld van 'n destruktiewe toets?

A X-straaltoets
B Kleurstofdeurdringingstoets
C Ultrasoniese toets
D Buigtoets (1)

1.11 Drukspanning kan as 'n interne krag in materiaal, wat weerstand bied teen 'n …, gedefinieer word.

A skuiflas
B treklas
C druklas
D lineêre las (1)

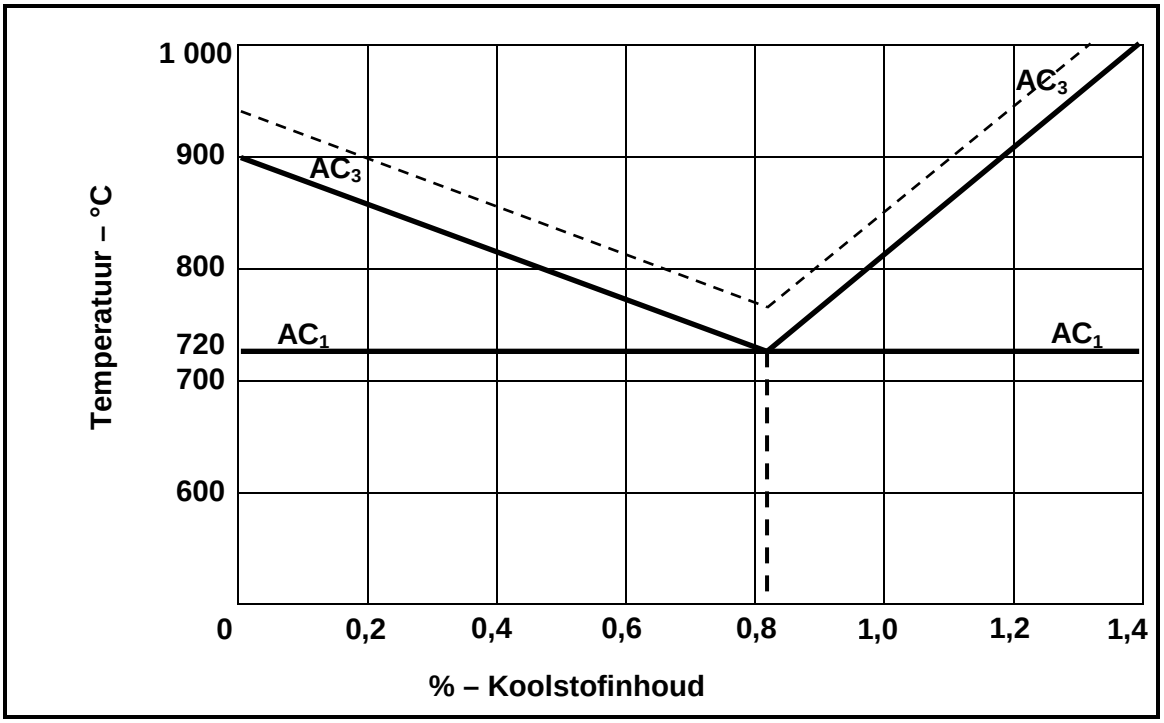
1.12 Watter EEN van die volgende stellings omskryf Pascal se wet?

A Die oppervlakte is omgekeerd eweredig aan die druk daarop uitgeoefen, indien die temperatuur konstant bly.
B Die druk uitgeoefen op die oppervlak van 'n vloeistof in 'n geslote hidrouliese stelsel word in gelyke mate in alle rigtings oorgedra.
C Die druk is eweredig aan die volume, indien die temperatuur konstant bly.
D Die volume is omgekeerd eweredig aan die druk daarop uitgeoefen, indien die temperatuur verhoog. (1)

1.13 Die volgende stelling beskryf 'n voordeel van 'n bandaandrywingstelsel in vergelyking met 'n rataandrywingstelsel:

A Sterker
B Het geen smering nodig nie
C Verander rigting
D Meer duursaam (1)

1.6 Staal kan verhard en teen 'n temperatuur tussen 885 °C en 925 °C uitgegloei word. Watter persentasie koolstofinhoud sal hierdie verharding en uitgloeiing toelaat? Gebruik die yster-koolstof-ewewigsdiagram in FIGUUR 1.1 hieronder.



FIGUUR 1.1

A 0,60%
B 0,20%
C 0,80%
D 0,40% (1)

1.7 Noem die gereedskapstuk wat gebruik word om die snybeitel haaks met die as van die werkstuk op te stel wanneer 'n skroefdraad in die draaibank gesny word:

A Skroefsteekmeter
B Skroefdraad-ringmaat
C Skroefdraadsetmaat
D Skroefmaat (1)

1.8 Wat is die standaardverhouding van 'n tapse spy?

A 1 in 50
B 1 in 100
C 1 in 150
D 1 in 75 (1)

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie opsies 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 A.

1.1 Watter veiligheidsmaatreël is op die MIG/MAGS-sweisproses van toepassing?

A Gebruik altyd 'n vonkaansteker om die brander aan die brand te steek en nie 'n vuurhoutjie of 'n sigaretaansteker nie.
B Die sweiser is ten volle geïsoleer met stewels en handskoene.
C Maak die silinderkleppe vinnig oop.
D Maak voorsiening vir suurstof- en asetileenlekke. (1)

1.2 Watter hardheidstoetser gebruik 'n staalbal om die hardheid van staal te bepaal?

A Vickers-toetser
B Rockwell-toetser
C Victor-toetser
D Brinell-toetser (1)

1.3 'n Gasanaliseerder word tydens die brandstofmengsel-instelling van 'n motorenjin gebruik. Watter EEN van die volgende is die KORREKTE oorsaak van 'n hoë koolstofmonoksiedlesing?

A Lae kompressie
B Geslyte kleppe
C 'n Verstopte lugfilter
D Geslyte suierringe (1)

1.4 Die funksie van die trektoetser:

A Om die drukspanning en breekstootspanning op 'n stuk materiaal te bepaal
B Om 'n trekspanning op 'n ondersteunde balk te demonstreer
C Om die defleksie van 'n eenvoudig ondersteunde balk te demonstreer
D Om die trekspanning, breektrekspanning en persentasie verlenging op 'n stuk materiaal te bepaal (1)

1.5 Wanneer koolstofstaal teen 'n eenvormige tempo verhit word, styg die temperatuur eweredig tot 700 °C. Die temperatuur bly dan vir 'n rukkie konstant. Hierdie punt staan as die … bekend

A afkoelingspunt
B smeltpunt
C laer kritieke punt
D verhittingspunt (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. 'n Formuleblad verskyn aan die einde van die vraestel.

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

VRAAG	INHOUD	PUNTE	TYD
1	Meervoudigekeuse-vrae	20	15 minute
2	Veiligheid	10	10 minute
3	Gereedskap en Toerusting	12	10 minute
4	Materiale	13	10 minute
5	Terminologie	30	20 minute
6	Hegtingsmetodes	25	25 minute
7	Kragte	30	30 minute
8	Instandhouding	15	15 minute
9	Stelsels en Beheer	25	25 minute
10	Turbines	20	20 minute
	TOTAAL	**200**	**180 minute**

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NASIONALE SENIOR SERTIFIKAAT

GRAAD 12

MEGANIESE TEGNOLOGIE

FEBRUARIE/MAART 2015

PUNTE: 200

TYD: 3 uur

Hierdie vraestel bestaan uit 14 bladsye en 'n 4 bladsy-formuleblad.

* M C H T D M *

EASTERN CAPE