



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2014

MECHANICAL TECHNOLOGY

MARKS: **200**

TIME: **3 hours**



This question paper consists of 21 pages, including a formula sheet.

INSTRUCTIONS AND INFORMATION

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

| QUESTION | CONTENT COVERED | MARKS | TIME |
|----------|-------------------------------------|------------|--------------------|
| 1 | Multiple-choice questions | 20 | 18 minutes |
| 2 | Safety | 10 | 9 minutes |
| 3 | Tools and equipment | 12 | 11 minutes |
| 4 | Materials | 13 | 12 minutes |
| 5 | Terminology (Manufacturing process) | 30 | 27 minutes |
| 6 | Joining methods | 25 | 22 minutes |
| 7 | Forces | 30 | 27 minutes |
| 8 | Maintenance | 15 | 13,5 minutes |
| 9 | Systems and control | 25 | 22,5 minutes |
| 10 | Turbines | 20 | 18 minutes |
| | TOTAL: | 200 | 180 minutes |

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various possible options are provided as answers to the following questions. Choose the correct answer and make a cross (X) in the block (A–D) next to the question number (1.1–1.20) in the ANSWER BOOK, e.g. 1.21 B.

1.1 Which ONE of the following is not an environmental hazard?

- A Noise
- B Illumination
- C Horseplay
- D Radiation

(1)

1.2 Safety precautions need to be adhered to when working with surface grinders. Which one does NOT fit?

- A Protective clothing and eye protection is essential.
- B Check if the tool rest is not more than three (3) mm from the wheel surface.
- C Understand all the operating instructions applicable to the machine.
- D Make sure all guards and safety devices are in place.

(1)

1.3 One of the following components is NOT part of a compression tester.



Which one does NOT fit?

- A Pressure adjuster
- B Pressure relieve valve
- C Pressure meter indicator
- D Spark plug adapter

(1)

1.4 Which of the following is used to measure the pitch diameter?

- A Depth micrometer
- B Screw-thread micrometer
- C Inside micrometer
- D Outside micrometer

(1)

1.5 Which of the following are NOT a use for medium carbon steel (0,25–0,55%)?

- A Crankshaft
- B Pliers
- C Screw driver
- D Rivets

(1)

1.6 The temperature where carbon steel changes from pearlite to austenite when heated is called the ...

- A recalescence point.
- B decalescence point.
- C lower critical point.
- D higher critical point.

(1)

1.7 Identify the milling operation as shown in FIGURE 1.8 below.

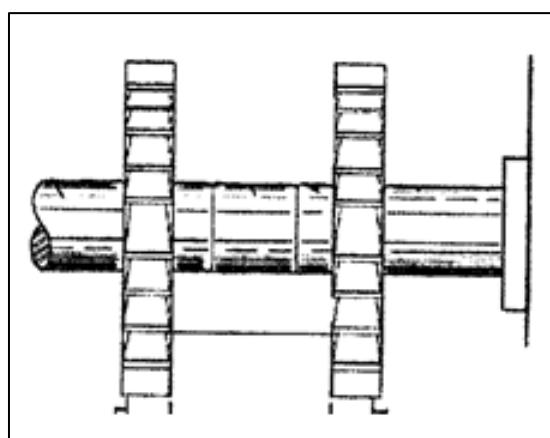


FIGURE 1.8

- A Face milling
- B Straddle milling
- C Gang milling
- D Centralised milling

(1)

1.8 When using a simple indexing movement on the dividing head, determine the amount of turns to be taken for a 5 teeth gear.

- A 5 full turns
- B 8 full turns
- C 12 full turns
- D 4 full turns

(1)

1.9 Which ONE of the following is NOT an arbor cutter?

- A Plain cutters
- B Staggered tooth cutters
- C Profile cutters
- D Woodruff cutters

(1)

1.10 Which of the following is a destructive test?

- A Liquid dye penetrant test
- B X-ray test
- C Nick bend test
- D Ultrasonic test

(1)

1.11 Which type of inert gas is used in MIG welding?

- A Acetylene
- B Oxygen
- C CO₂ mixed with argon
- D Nitrogen

(1)

1.12 Indicate the correct answer for the abbreviation of a UDL, as used in the calculations of moments in engineering components.

- A Uniform depth load
- B Universal design load
- C Uniformly destructive load
- D Uniformly distributed load

(1)

1.13 Which component is directly proportional to the applied load and inversely proportional to the cross sectional area of the body?

- A Strain
- B Young's modulus of elasticity
- C Change in length
- D Stress

(1)

1.14 The PCMO (passenger car motor oil) must perform many functions and should be aligned with the basic fundamentals of lubrication theory. Choose the INCORRECT statement.

- A Separates moving components by forming a film of lubricant between them.
- B Cleans deposits and sludge from engine surfaces that prevent the formation of varnish or lacquering on the piston.
- C Minimises wear in areas of the engine where loads are high or speeds are low.
- D The oil must foam and be unable to resist oxidation.

(1)

1.15 Which of the lubricants properties below can be defined as the lowest temperature at which oil gives off vapours which can ignite?

- A Pour point
- B Flash point
- C Viscosity
- D Ground point

(1)

1.16 What is the function of the ECU in a motor vehicle?

- A Receiving data from the engine
- B Receiving data from the electronic control system
- C Receiving data from the carburettor
- D Receiving data from the alignment system

(1)

1.17 Which of the following statements defines Boyle's law?

- A The volume of gas is inversely proportional to the pressure on it, if the temperature remains constant.
- B The ratio between the stress and strain in a metal.
- C The reluctance of a body to move.
- D An internal force in material which resists a shearing load or force.

(1)

1.18 Hydraulics refers to the transmission and control of forces and movement by means of ...

- A volume.
- B fluid.
- C load.
- D gas.

(1)

1.19 Which of the following is an advantage of a supercharger in comparison to a turbocharger?

- A To install, it requires extensive modifications of the exhaust system.
- B Must idle before shut down.
- C Do not suffer lag.
- D Are lubricated by engine oil.

(1)

1.20 Identify the charger shown below and select the correct answer.



- A Supercharger
- B Double charger
- C Steam charger
- D Turbocharger

(1)

[20]

QUESTION 2: SAFETY

Study FIGURE 2.1 below.

**FIGURE 2.1**

- 2.1 Name any FOUR safety rules that must be observed when working with a hydraulic press. (4)
- 2.2 State if the following statements are TRUE or FALSE:
- 2.2.1 It is the learner's responsibility to report unsafe/unhealthy conditions in the work place. (1)
- 2.2.2 Always use the correct spanner to tighten the clamps of a bearing puller. (1)
- 2.2.3 The surface grinder can be operated without proper eye protection. (1)
- 2.2.4 It is safe to adjust guards while the power saw is in motion. (1)
- 2.3 List any TWO safety particulars that must be visible on the label of a gas cylinder. (2)
[10]

QUESTION 3: TOOLS AND EQUIPMENT

- 3.1 Explain the procedure step by step when connecting the gas analyser to the exhaust pipe of a motor vehicle to test the CO₂ to analyse the gas emitted by the exhaust pipe. (6)
- 3.2 Mention a function and a care for the following tools being used in a work place in the column below.

| Tool | Function | Care |
|----------------|-----------|-----------|
| Cooling tester | 3.2.1 ... | 3.2.2 ... |
| Torsion tester | 3.2.3 ... | 3.2.4 ... |
| Spring tester | 3.2.5 ... | 3.2.6 ... |

(6)
[12]

QUESTION 4: MATERIALS

- 4.1 State any FOUR different crystal structures that are indicated on an iron-carbon equilibrium diagram. (4)
- 4.2 Study FIGURE 4.2 below and identify the THREE temperature points on the critical temperature diagram of 0,83% carbon steel, where different changes take place, whether heating or cooling. (3)

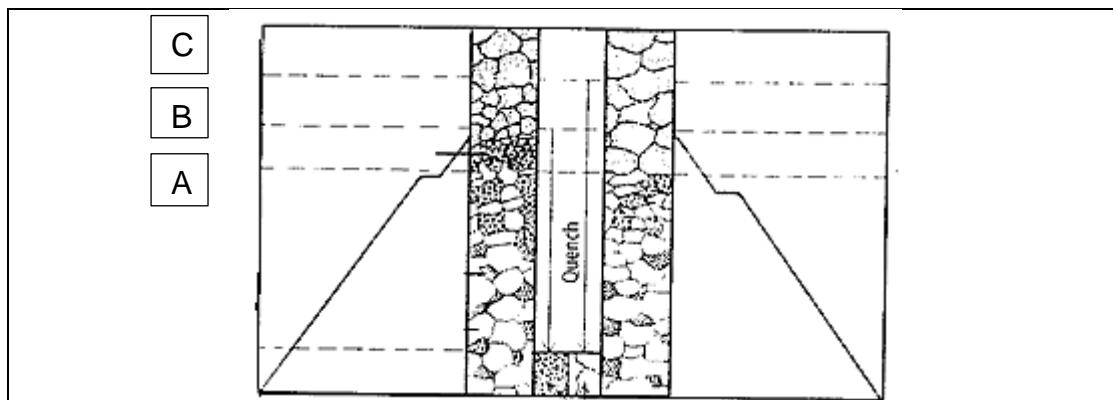


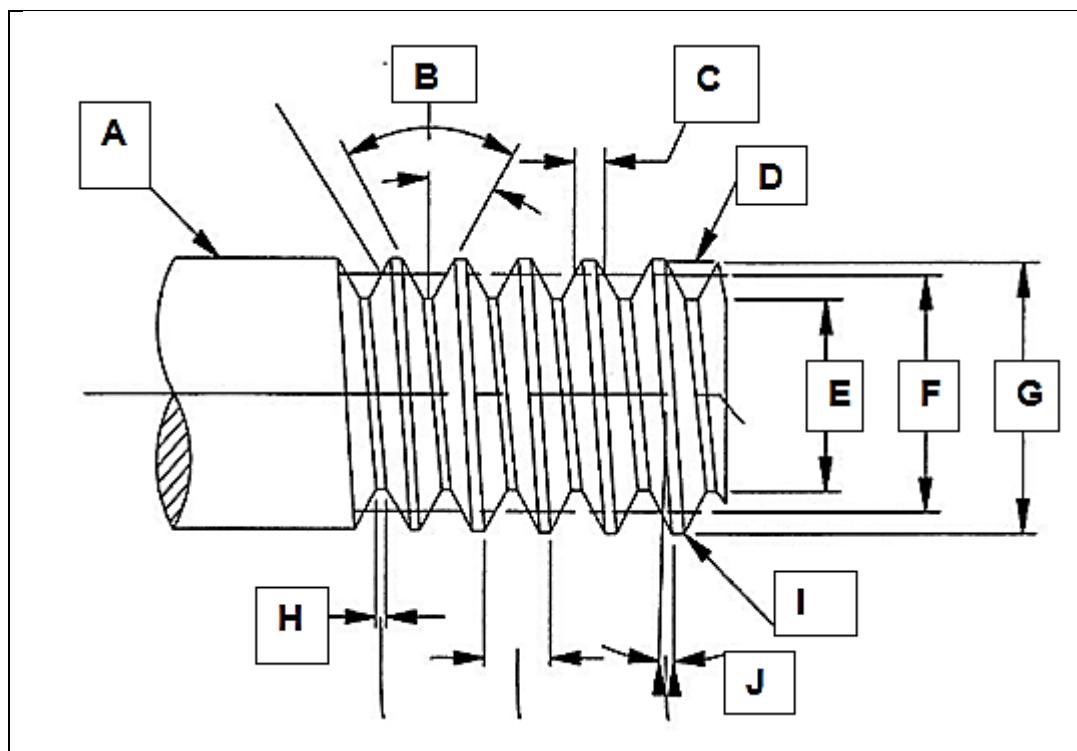
FIGURE 4.2

- 4.3 Give a brief explanation of the iron-carbon equilibrium diagram with reference to the following:
- 4.3.1 Carbon content (3)
- 4.3.2 Temperature (3)

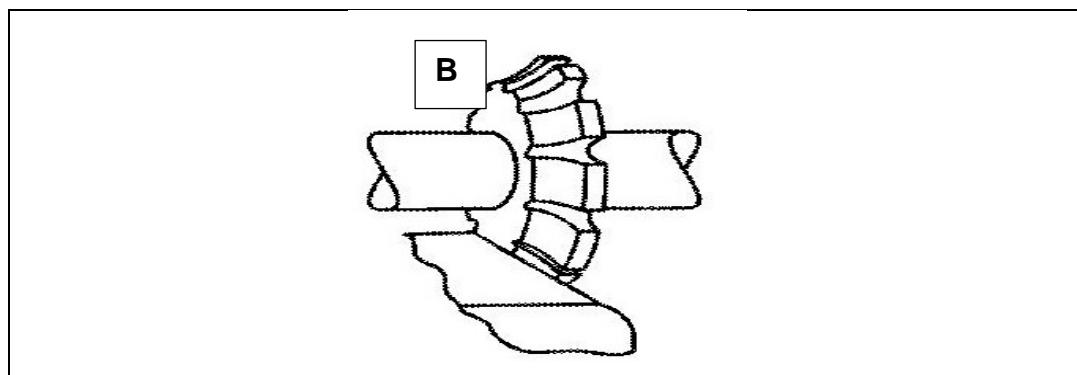
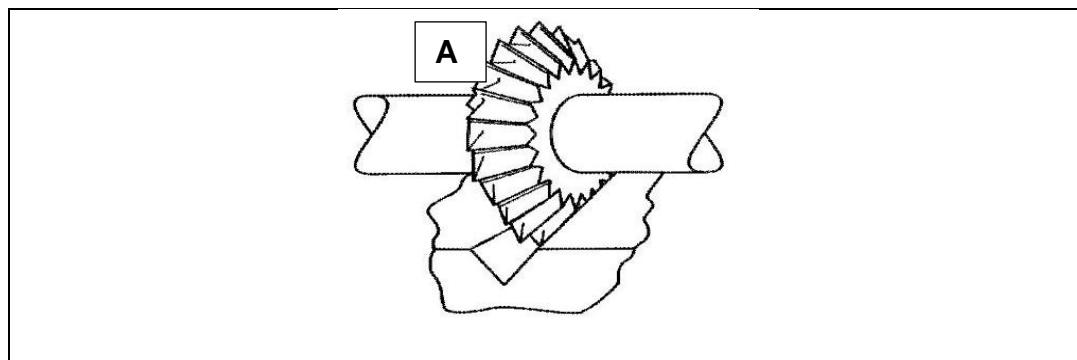
[13]

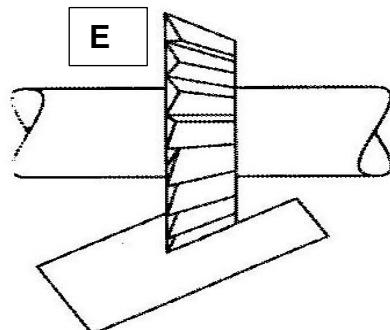
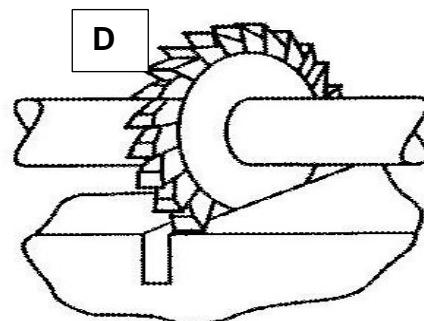
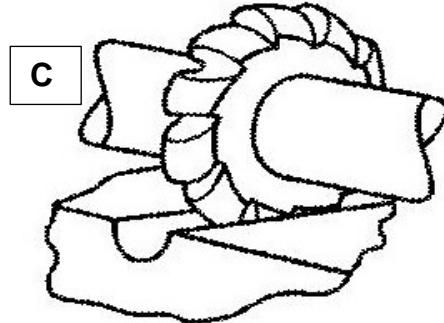
QUESTION 5: TERMINOLOGY

5.1 Study the screw thread and identify the parts A–J as shown below.



5.2 Identify the milling cutters from A–E as shown in the sketches that follow:





(5)

- 5.3 Draw neat sketches to demonstrate the difference between up-cut milling and down-cut milling. (6)

- 5.4 Calculate the indexing required in cutting 32 teeth on the circumference of a round bar. (4)

- 5.5 Calculate the width of a key way to be cut on a 50 mm shaft and describe how you would centre a 20 mm wide side and face cutter to cut the key way. (5)
[30]

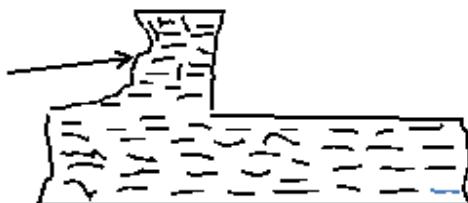
QUESTION 6: JOINING METHODS

- 6.1 Explain the difference between non-destructive and destructive tests that can be performed on welded joints. (2)
- 6.2 Study the TWO welding defects below and identify a cause and cure for each defect:

6.2.1



6.2.4

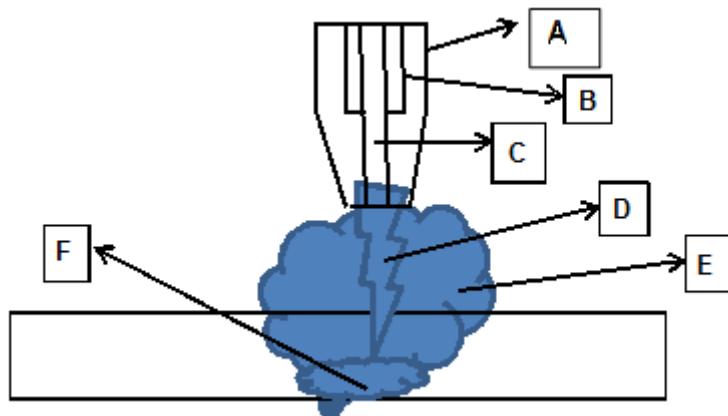


Tabulate your answer as follows:

| Defect | Cause | Cure |
|-----------|-----------|-----------|
| 6.2.1 ... | 6.2.2 ... | 6.2.3 ... |
| 6.2.4 ... | 6.2.5 ... | 6.2.6 ... |

(6)

- 6.3 Explain the procedure when the ultra-sonic testing method is performed on welded joints. (6)
- 6.4 Mention FIVE visual inspections of a good weld. (5)
- 6.5 Identify the labels of the Mig welding process shown in the illustration (FIGURE 6.5) below.

**FIGURE 6.5**(6)
[25]

QUESTION 7: FORCES

- 7.1 A tensile force of 100 kN is applied to a round steel bar. The bar has a diameter of 50 mm and a length of 10 m. Young's Modulus for this steel is 200 GPa.

Calculate:

7.1.1 The cross sectional area of the bar (3)

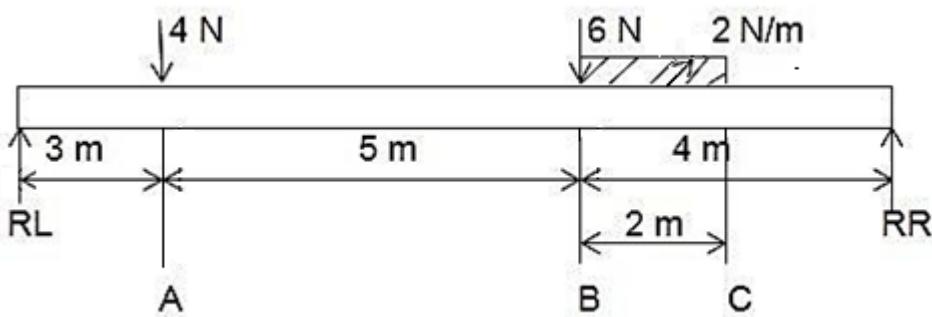
7.1.2 The stress (3)

7.1.3 The strain (2)

7.1.4 The extension of the bar due to the force (3)

- 7.2 Draw the stress-strain diagram and indicate all the important points on the graph. (7)

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



Calculate:

7.3.1 The magnitude of RL and RR (4)

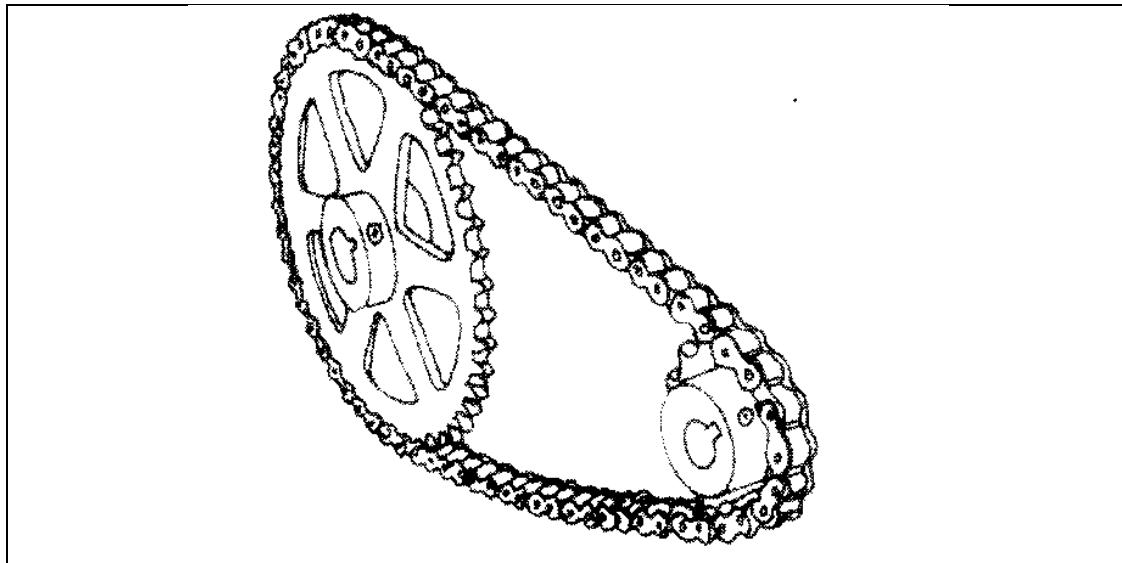
7.3.2 The bending moments at points A, B and C (3)

- 7.4 How would you 'perform' an advance test with the beam tester to determine the deflection at any given bending moment of various materials? (5)

[30]

QUESTION 8: MAINTENANCE

- 8.1 Modern lubricating oils must fulfil certain requirements to prolong the lifespan of an engine. Explain the following properties of oil:
- 8.1.1 Viscosity (2)
- 8.1.2 Pour point (2)
- 8.2 Study FIGURE 8.2 below and give a brief description of how you would go about replacing a chain drive.



(6)

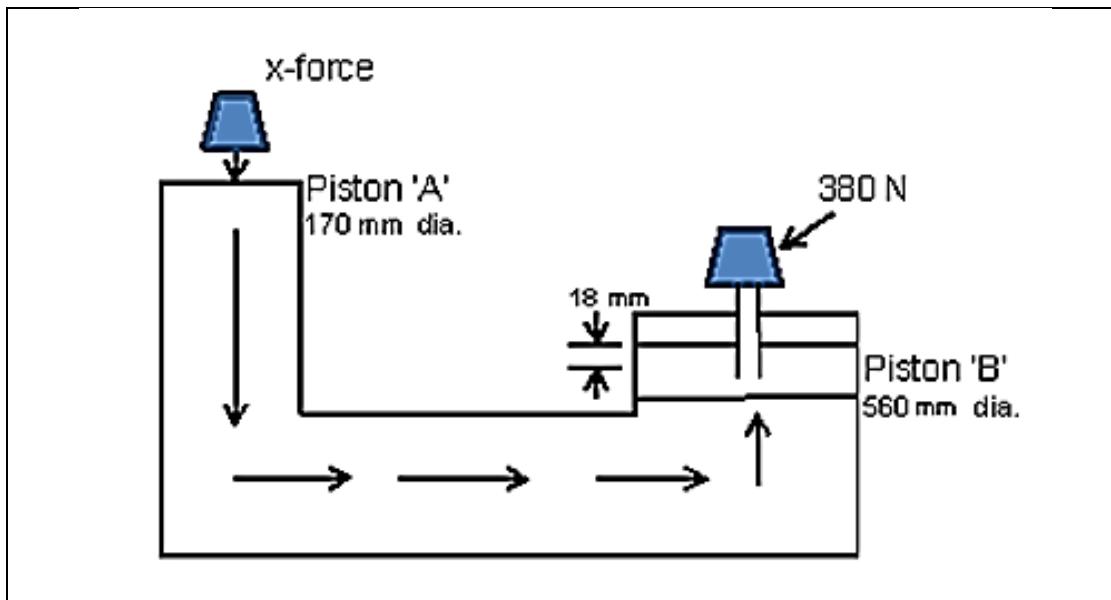
FIGURE 8.2

- 8.3 How would you maintain the efficiency of cutting fluid on a lathe? (3)
- 8.4 What is the main reason why belt drives must be maintained? (2)

[15]

QUESTION 9: SYSTEMS AND CONTROL

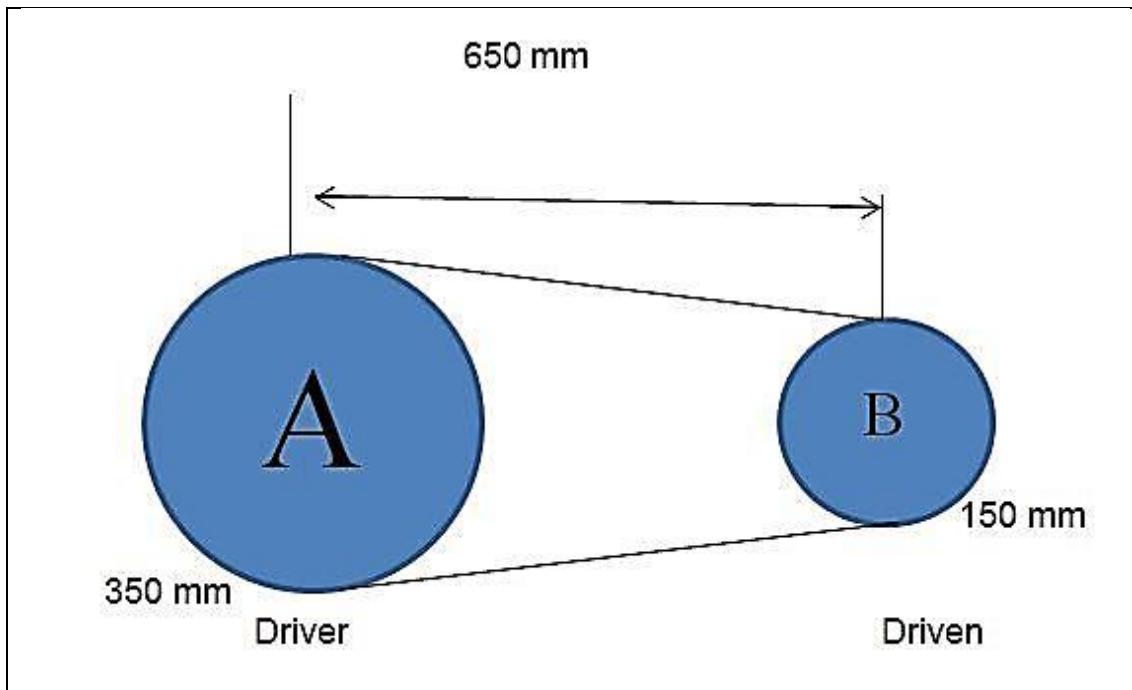
- 9.1 The drawing below illustrates a hydraulic press. A force applied on piston 'A' induces a force of 380 N on piston 'B' of the press. This causes piston 'B' to move 18 mm upwards. The diameter of piston 'A' is 170 mm and piston 'B' is 560 mm.



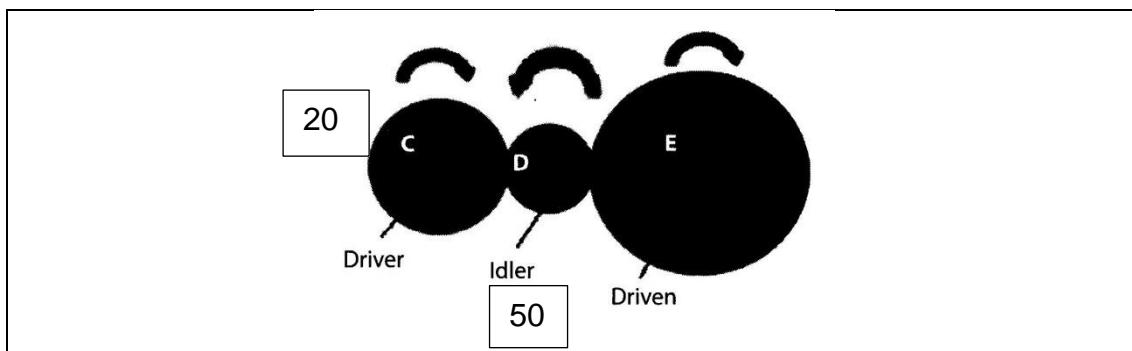
Calculate:

- 9.1.1 The force applied on piston 'A' (4)
9.1.2 The volume displaced by piston 'B' (4)
9.1.3 The distance the piston 'A' moves downwards in mm (2)

- 9.2 The following information is provided. The distance between driving pulley A and driven pulley B is 650 mm. The driving pulley diameter is 350 mm and the diameter for the driven pulley is 150 mm. The driving pulley rotates at 450 revs/min. Calculate the speed of the driven pulley.



- 9.3 A gear drive consists of 3 gears; gear C with 20 teeth, turns at 100 r/sec and meshes with an idler gear, with 50 teeth. Gear D meshes with gear E, which turns at 25 r/sec.



Calculate:

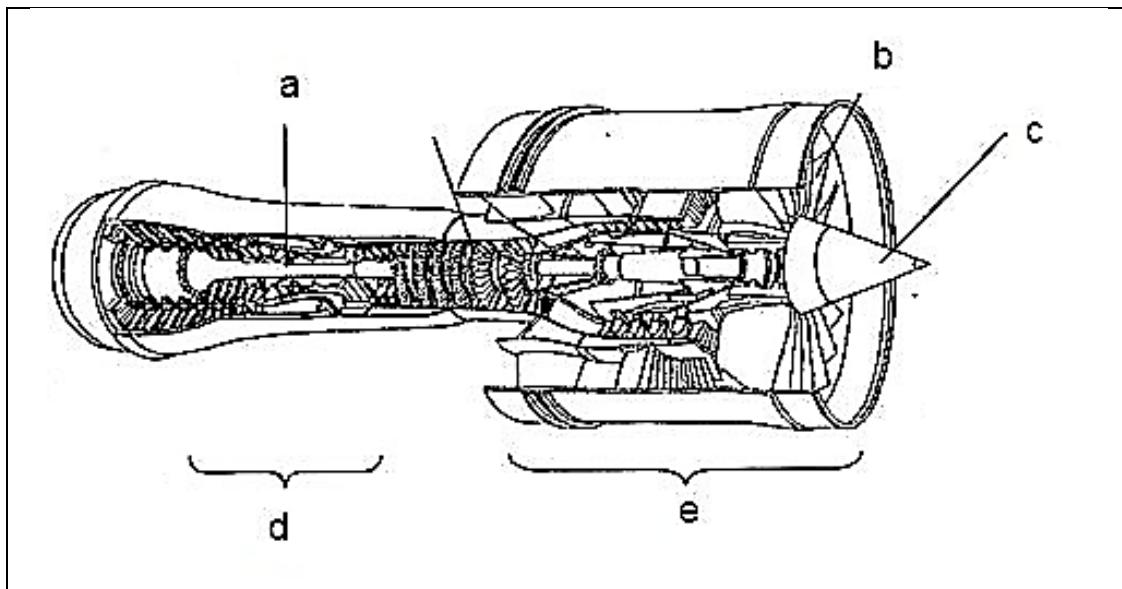
9.3.1 The rotational frequency (revs) of gear D (3)

9.3.2 The number of teeth on gear E (3)

- 9.4 A gas occupies a volume of $0,08 \text{ m}^3$ at a pressure of 3,8 MPa. Calculate the pressure, if the volume is changed to $0,22 \text{ m}^3$ at a constant temperature and the pressure is changed to 7,9 MPa at a constant temperature. (6)
[25]

QUESTION 10: TURBINES

- 10.1 Explain the operation principles of an impulse turbine. (5)
- 10.2 Name FIVE types of steam turbines. (5)
- 10.3 Identify the labels (a – e) on the gas turbine as shown in the illustration below.



- 10.4 Explain the working operation of a turbocharger. (5)
[20]

TOTAL: 200

MECHANICAL TECHNOLOGY: GRADE 12-FORMULA SHEET**1. BELT DRIVES**

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

$$1.2 \quad \text{Belt speed} = \frac{\pi(D + t)x N}{60} \quad (t = \text{belt thickness})$$

$$1.3 \quad \text{Belt mass} = \text{Area} \times \text{length} \times \text{density} \quad (A = \text{thickness} \times \text{width})$$

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

$$1.5 \quad \text{Output speed} = \frac{\text{drive pulley}}{\text{driven pulley}} \times \frac{\text{drive pulley}}{\text{driven pulley}} \times \text{input speed}$$

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

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

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

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

$$1.10 \quad \text{Power } (P) = \frac{(T_1 - T_2)\pi DN}{60} \quad \text{where } T_1 = \text{force in the tight side}$$

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

2. FRICTION CLUTCHES

$$2.1 \quad \text{Torque } (T) = \mu WnR$$

μ = coefficient of friction

W = total force

n = number of friction surfaces

R = effective radius

$$2.2 \quad \text{Power } (P) = \frac{2\pi NT}{60}$$

3. STRESS AND STRAIN

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

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

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

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

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

4. HYDRAULICS

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

$$4.2 \quad Volume = \text{Cross-sectional area} \times \text{stroke length } (l \text{ or } s)$$

$$4.3 \quad \text{Volume liquid displaced by plunger} = \text{volume liquid displaced by ram}$$

$$4.4 \quad Volume = \text{Area} \times \text{stroke length}$$

5. WHEEL AND AXLE

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

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

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

6. LEVERS

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

$$6.2 \quad \text{Input movement } (IM) = \text{Effort} \times \text{distance moved by effort}$$

$$6.3 \quad \text{Output movement } (OM) = \text{load} \times \text{distance moved by load}$$

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

7. GEAR DRIVES SPUR GEAR

$$7.1 \quad Power (P) = \frac{2\pi NT}{60}$$

$$7.2 \quad Gear ratio = \frac{\text{Product of number of teeth on driven gears}}{\text{Product of number of teeth on driving gears}}$$

$$7.3 \quad \frac{N_{input}}{N_{output}} = \frac{\text{product of number of teeth on driven gears}}{\text{product of number of teeth on driving gears}}$$

$$7.4 \quad Torque = force \times radius$$

$$7.5 \quad Torque transmitted = gear ratio \times input torque$$

$$7.6 \quad Module (m) = \frac{\text{pitch circle diameter (PCD)}}{\text{number of teeth (T)}}$$

$$7.7 \quad \text{Pitch circle diameter (PCD)} = \frac{\text{circular pitch (CP)} \times \text{number of teeth (T)}}{\pi} \text{ or } PCD = T \times m$$

$$7.8 \quad Outside diameter (OD) = PCD + 2 \text{ module} \quad \text{or} \quad OD = m(T + 2)$$

$$7.9 \quad Addendum (a) = module (m)$$

$$7.10 \quad Dedendum (b) = 1,157 \text{ m} \quad \text{or} \quad Dedendum (b) = 1,25 \text{ m}$$

$$7.11 \quad Cutting depth (h) = 2,157 \text{ m} \quad \text{or} \quad Cutting depth (h) = 2,25 \text{ m}$$

$$7.12 \quad Clearance (c) = 0,157 \text{ m} \quad \text{or} \quad Clearance (c) = 0,25 \text{ m}$$

$$7.13 \quad Circular pitch = \pi \times m$$

$$7.14 \quad Work depth = 2 \times add \quad \text{or} \quad work depth = 2 \times m$$

8. SCREW THREADS

$$8.1 \quad \text{Pitch circle diameter: } PCD = T \times m_r$$

$$8.2 \quad Addendum (a) = module (m_n)$$

$$8.3 \quad Dedendum = 1,157 \text{ m}_n$$

$$8.4 \quad Clearance = 0,157 \text{ m}_n$$

$$8.5 \quad Outside diameter (OD) = PCD + 2 \text{ addendum}$$

$$8.6 \quad T = \frac{SSD}{m_r}$$

$$8.7 \quad (\text{Normal module}) m_n = (\text{module real}) m_r \cos \theta$$

8.8 Number of teeth marked on milling cutter: $Nr = \frac{T}{(\cos \theta)^3}$

8.9 Helix angle: θ
 $TAN \theta = \frac{\pi \times PCD}{Lead \text{ of work piece}}$

8.10 Lead of work piece = $\frac{\pi \times PCD}{TAN \theta}$

8.11 Lead of milling machine = dividing head ratio \times lead screw pitch

8.12 Change gears: $\frac{Dr}{Dn} = \frac{\text{lead of machine}}{\text{lead of work piece (gear)}}$

8.13 Circle pitch = $\pi \times m_n$

8.14 The milling machine has a table lead screw with a 6 mm pitch unless stated otherwise.

9. SCREW THREADS

9.1 Pitch diameter (D_e) = $OD - (0.5 \times \text{pitch})$

9.2 Lead = pitch \times number of starts

9.3 Helix angle: θ
 $TAN \theta = \frac{\text{lead}}{\pi \times D_e}$

9.4 Leading angle = $90^\circ - (\text{helix angle} + \text{clearance angle})$

9.5 Following = $90^\circ + (\text{helix angle} - \text{clearance angle})$

9.6 Clearance angle = 3° unless stated differently

10. 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 |

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

10.2 Change gears: $\frac{Dr}{Dn} = \frac{Dr}{Dv} = (A - n) \times \frac{40}{A}$ or $\frac{Dr}{Dv} = \frac{(A-n)}{A} \times \frac{40}{1}$

10.3 Angle ind = $\frac{\text{angle in minutes}}{540'}$

11. CALCULATIONS OF FEED

$$11.1 \quad \text{Feed } (f) = f_1 \times T \times N$$

Where f = feed per millimetre per minute

f_1 = feed per tooth in millimetres

T = number of teeth in cutter

N = number of revolutions of cutter per minute

$$11.2 \quad \text{Cutting speed } (V) = \pi \times D \times N$$

Where D = diameter of the cutter in metres

11. BEREKENINGE TEN OPSIGTE VAN TOEVOER

$$11.1 \quad \text{Toevoer} (f) = f_1 \times T \times N$$

$$11.2 \quad \text{Syngroed} (V) = \pi \times D \times N$$

Waar D = diameter van die syner in meter
 N = aantal omwentellings van die syner per minuut

f_1 = toevoer in tand per millimeter
 f_1 = toevoer in millimeter per minuut
 T = aantal tanden van die syner
 N = aantal omwentellings van die syner per minuut

| | |
|------|---|
| 10.1 | $Eenvoudige indeksering = \frac{n}{40}$ (waar $n = \text{getal indeksing}s$) |
| 10.2 | $Wisselrate: \frac{Dn}{Dr} = \frac{A}{(A-n)} \times \frac{40}{A} \text{ of } \frac{Gd}{Dr} = \frac{A}{(A-n)} \times \frac{1}{40}$ |
| 10.3 | $Hoeke ind = \frac{540^\circ}{hoeke in minute}$ |

10. VERDEELKOPTABEL VIR FREESMASJIEËN

| | |
|-----|--|
| 9.1 | $Stekdiameter (D_s) = BD - (0,5 \times stek)$ |
| 9.2 | $Stygning = stek \times aantal beginne$ |
| 9.3 | $Helikshoek: \theta = \frac{\pi \times D_e}{stygning}$ |
| 9.4 | $Ingryphoek = 90^\circ - (\text{helikshoek} + \text{vryloophoek})$ |
| 9.5 | $Sliepshoek = 90^\circ + (\text{helikshoek} - \text{vryloophoek})$ |
| 9.6 | $Vryloophoek = 3^\circ \text{ tensy anders vermeld}$ |

9. SKROEFDRADE

| | |
|-------|---|
| 8.1.1 | $Lengte stygning van freesmasjién = verdeelkopverhouding \times leiskröefstek$ |
| 8.1.2 | $Wisselrate benodig: \frac{Dn}{Dr} = \frac{stygning van werkstuuk (rat)}{stygning van masjién}$ |
| 8.1.3 | $Strikelsteek = \pi \times m_a$ |
| 8.1.4 | Dit freesmasjién het 'n tafelleiskroef met 'n 6 mm stek tensy anders vermeld. |
| 8.2 | $TAN \theta = \frac{\pi \times D_e}{stygning}$ |
| 8.3 | $Helikshoek: \theta = \frac{\pi \times D_e}{stygning}$ |
| 8.4 | $Ingryphoek = 90^\circ - (\text{helikshoek} + \text{vryloophoek})$ |
| 8.5 | $Sliepshoek = 90^\circ + (\text{helikshoek} - \text{vryloophoek})$ |
| 8.6 | $Vryloopshoek = 3^\circ \text{ tensy anders vermeld}$ |

$$8.7 \quad (\text{Normale module}) m_w = (\text{werklike module}) m_w \cos \theta$$

$$8.6 \quad T = \frac{m_w}{SSD}$$

$$8.5 \quad \text{Buitediameter} (BD) = SSD + 2 \text{ addendum}$$

$$8.4 \quad \text{Vryruimte} = 0,157 \text{ m}$$

$$8.3 \quad \text{Dedendum} = 1,157 \text{ m}$$

$$8.2 \quad \text{Addendum} (a) = \text{module} (m)$$

$$8.1 \quad \text{Steksrakel diameter} SSD = T \times m_w$$

8. HELIESE TANDRATE

$$7.14 \quad \text{Werkdipepte} = 2 \times \text{addendum} \quad \text{of} \quad \text{werkdipepte} = 2 \times m$$

$$7.13 \quad \text{Strikelsleek} = \pi \times m$$

$$7.12 \quad \text{Vryruimte} (c) = 0,157 \text{ m of } \text{Vryruimte} (c) = 0,25 \text{ m}$$

$$7.11 \quad \text{Syndipepte} (h) = 2,157 \text{ m of } \text{Syndipepte} (h) = 2,25 \text{ m}$$

$$7.10 \quad \text{Dedendum} (b) = 1,157 \text{ m of } \text{Dedendum} (b) = 1,25 \text{ m}$$

$$7.9 \quad \text{Addendum} (a) = \text{module} (m)$$

$$7.8 \quad \text{Buitediameter} (BD) = SSD + 2 \text{ module} \quad \text{of} \quad BD = m(T + 2)$$

$$7.7 \quad \text{Steksrakel diameter} (SSD) = \frac{\text{strikelsleek} (SS) \times \text{aantaltand} (T)}{\pi} \quad \text{of} \quad SSD = T \times m$$

$$7.6 \quad \text{Module} (m) = \frac{\text{steksrakel diameter} (SSD)}{\text{getal tand} (T)}$$

$$7.5 \quad \text{Wringkrag oorgedra} = \text{ratverhouding} \times \text{insetwringkrag}$$

$$7.4 \quad \text{Wringkrag} = \text{krag} \times \text{radius}$$

$$7.3 \quad \frac{N_{\text{inset}}}{N_{\text{uitset}}} = \frac{\text{prodruk van die aantal tandie op die gedrewe rate}}{\text{prodruk van die aantal tandie op die dryfrate}}$$

$$7.2 \quad \text{Ratverhouding} = \frac{\text{getal tandie op gedrewe rat}}{\text{getal tandie op dryfrat}}$$

$$7.1 \quad \text{Drywining} (P) = \frac{60}{2\pi N_T}$$

7. REGULITANDRAT

7.

$$6.4 \quad \text{Snelheidswerhouding (VR)} = \frac{\text{Uitsetbeweging}}{\text{Insetbeweging}}$$

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

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

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

6. HEBOME

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

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

$$5.1 \quad \text{Snelheidswerhouding (VR)} = \frac{\text{las afstand}}{\text{hyskrag afstand}} = \frac{d_2 - d_1}{2D}$$

5. WIEL EN AS

$$4.4 \quad \text{Volume} = \text{Oppervlakte} \times \text{slaglengte}$$

$$4.3 \quad \text{Volume vloeiweis of plunjier verplas} = \text{Volume vloeiweis of ram verplas}$$

$$4.2 \quad \text{Volume} = \text{dwarsdeursnee-oppervlakte} \times \text{slaglengte (l of s)}$$

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

4. HIDROULIKA

$$3.5 \quad A_{ps} = \frac{4}{\pi(D_2 - d_2)}$$

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

$$3.3 \quad \text{Young se modules (E)} = \frac{\text{vormverandering of } \left(\frac{e}{D}\right)}{\text{spannning}}$$

$$3.2 \quad \text{Vormverandering (e)} = \frac{\text{verandering in lengte(L)}}{\text{verandering in lengte(AL)}}$$

$$3.1 \quad \text{Spanning} = \frac{\text{Oppervlakte of } G}{\text{Krag}} = \frac{A}{F}$$

3. SPANNING EN VORMVERANDERING

MEGANIESE TEGNOLOGIE: GRAAD 12-FORMULABLAD

1. BANDAANDRYWING

$$I.1 \quad \text{Bandspoeed} = \frac{60}{\pi D_N}$$

$$I.2 \quad \text{Bandspoeed} = \frac{60}{\pi(d+t)N} \quad (t = \text{banddikte})$$

$$I.4 \quad \text{Spoeedverhouding} = \frac{\text{Diameter van gedrewe katoen}}{\text{Diameter van dryfkatrol}}$$

$$I.3 \quad \text{Bandmassa} = \text{Area} \times \text{lengte} \times \text{digtheid} \quad (A = \text{dikte} \times \text{wydte})$$

$$I.5 \quad \text{Uitsetspoed} = \frac{\text{gedrewe katoen}}{\text{dryfkatrol}} \times \frac{\text{gedrewe katoen}}{\text{dryfkatrol}} \times \text{insetspoed}$$

$$I.6 \quad \text{Oppbandengte} = \frac{2}{(d-a)} + \frac{4c}{(d-a)^2} + 2c$$

$$I.7 \quad \text{Gekruisde bandengte} = \frac{2}{(d+a)} + \frac{4c}{(d+a)^2} + 2c$$

$$I.10 \quad \text{Drywing}(P) = \frac{60}{(T_1 - T_2) \pi D_N} \quad \text{waar } T_1 = \text{krag in die stywe kant}$$

$$I.11 \quad W_ydte = \frac{\text{Toelatbare krag}}{T_1}$$

$$2.1 \quad W_{\text{rywingskrag}}(T) = u W_R$$

2. WRYWINGSKOPELLARS

$$2.2 \quad \text{Drywing}(P) = \frac{60}{2\pi N T}$$

R = effektiewe radius

n = aantal rywingskoppe per volkake

W = totale druk

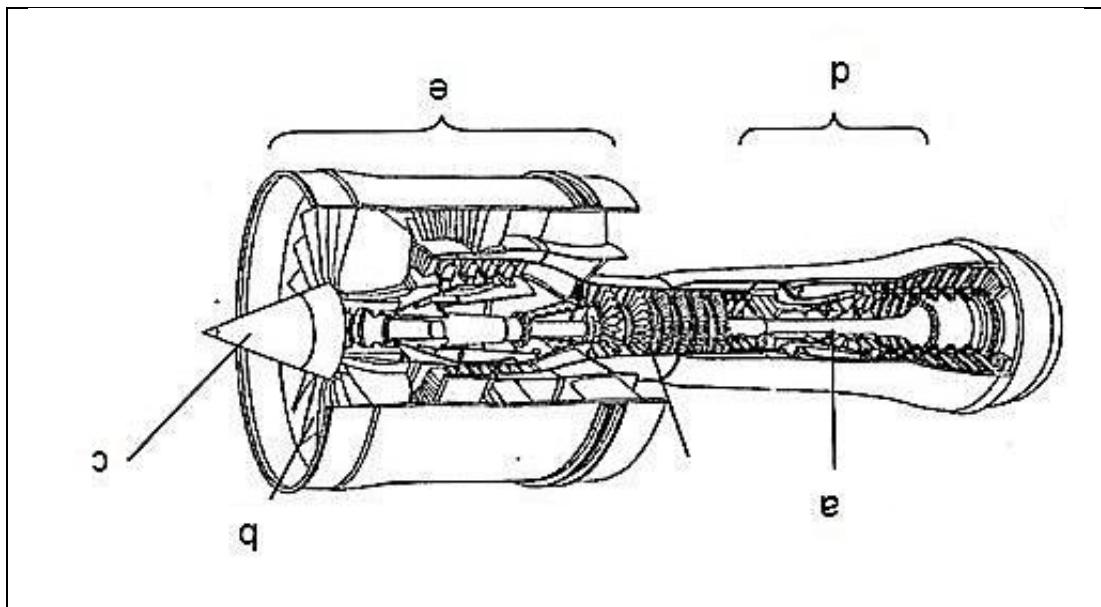
u = rywingskoefisiënt

TOTALL: 200

[20]
(5)

- 10.4 Verduidelik die werksgeniseel van 'n turboaanjaer.

(5)



(5)

- 10.3 Identifiseer die gedeltes (a – e) op die skeets van die gasturbine soos aangegeui in die onderstaande illustrasie.

(5)

- 10.2 Noem VYF soorte stoomturbines.

(5)

- 10.1 Verduidelik die werksgeniseel van 'n impulssturbine.

VRAAG 10: TURBINES

[25]

(6)

- 9.4 'n Gas beslaan 'n volume van $0,08 \text{ m}^3$ teen 'n druk van $3,8 \text{ MPa}$. Bereken die druk, indien die volume verander na $0,22 \text{ m}^3$ teen 'n konstante temperatuur en die druk verander na $7,9 \text{ MPa}$ teen 'n konstante temperatuur.

9.4

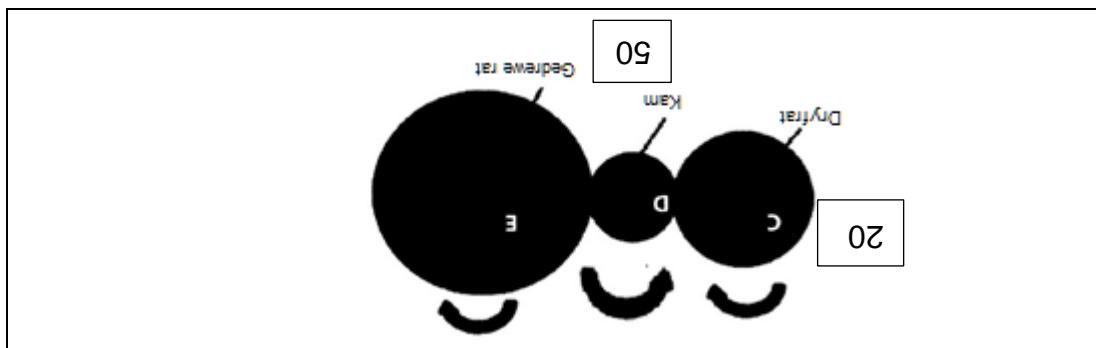
(3)

- 9.3.2 Die getal tande op rat E

(3)

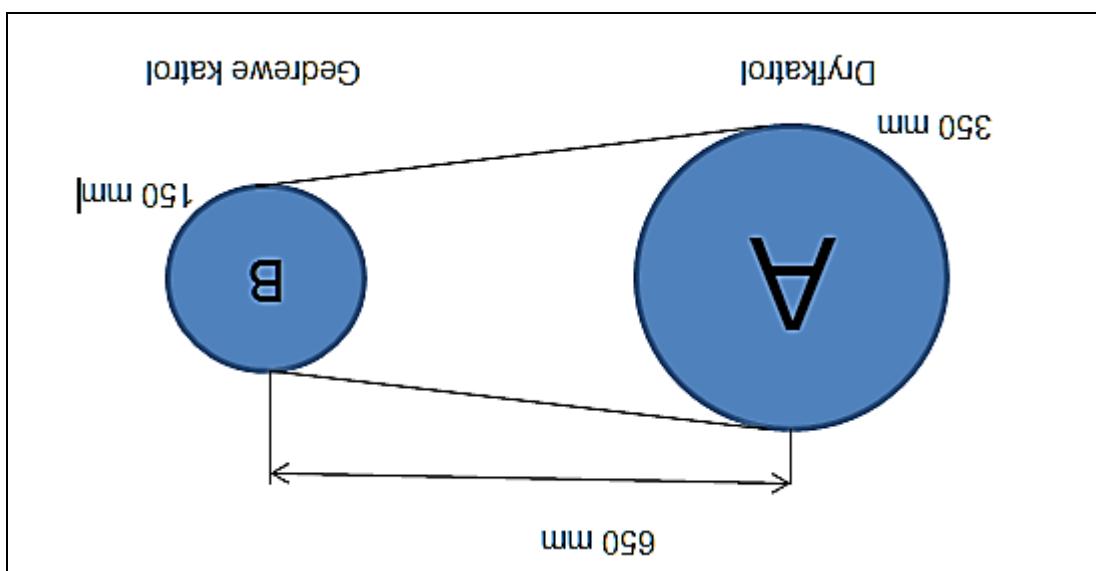
- 9.3.1 Die rotasiegetal (RPM) van rat D

Bereken:



- 9.3 'n Rat aan drywing bestaan uit 3 rante: rat C met 20 tande, draai teen 100 rev/sek en kam in met 'n tussenrat, met 50 tande. Rat D kam in met rat E, en draai teen 25 rev/sek.

9.3

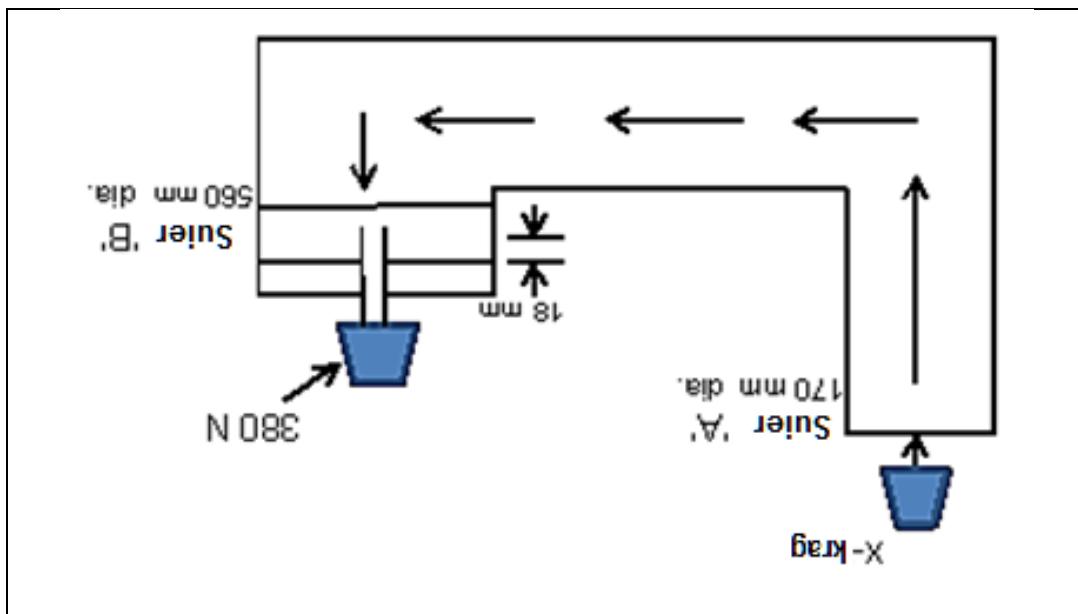


- 9.2 Die volgende inligting word gevgee: Die afstand tussen dryfkartol 'A' en gedrewe kartol 'B' is 650 mm. Die dryfkartol se diameter is 350 mm en die diameter vir die gedrewe kartol is 150 mm. Die gedrewe kartol roteer teen 450 rev/min. Bereken die spoed van die aangedrewe kartol.

9.2

- 9.1.1 Die krag wat op suier 'A' toegepas word (4)
- 9.1.2 Die volume wat suier 'B' verplaas (4)
- 9.1.3 Die afstand wat suier 'A' afwaarts beweeg in mm (2)

Bereken:



- 9.1 Die onderstaande illustrer 'n hidroulike stelsel. 'n Krag word op suier A toegepas en veroorsaak 'n krag van 380 N op suier B, van die pers. Dit veroorsaak dat suier 'B' 18 mm opwaarts beweeg. Die diameter van suier A is 170 mm en suier 'B' is 560 mm.

VRAAG 9: STELSELS EN BEHEER

[15]

(2)

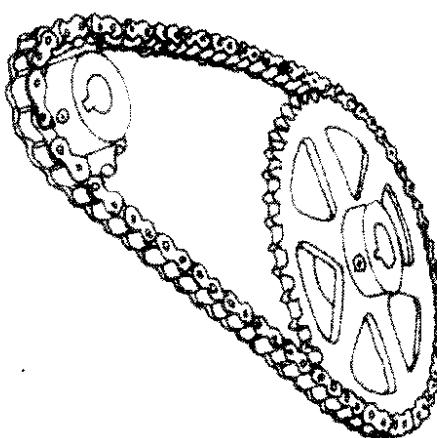
8.4 Wat is die hoofdoel waarom bandasandrywings onderhou moet word?

(3)

8.3 Hoe sal jy die syvalleisot op 'n draaibank doeltreffend bewerksteilig?

(6)

FIGUUR 8.2



(2)

8.2 Bestudeer FIGUUR 8.2 hieronder en verduidelik kortlik hoe jy die vervanging van 'n kettinggasandrywing sal behartig.

(2)

8.1.2 Vloeipunt

8.1.1 Viskositeit

8.1 Moderne smeermiddelolie moet aan sekere vereistes voldoen om die enjin se tydsduur te verleng. Verduidelik die volgende eienskappe van olie:

VRAAG 8: INSTANDHOUING

[30]

(5)

buigmomente van verskeie stukke materiaal te bepaal?

Hoe word h gevorderde toets met 'n bakkosteer uitgevoer om gegewe

7.4

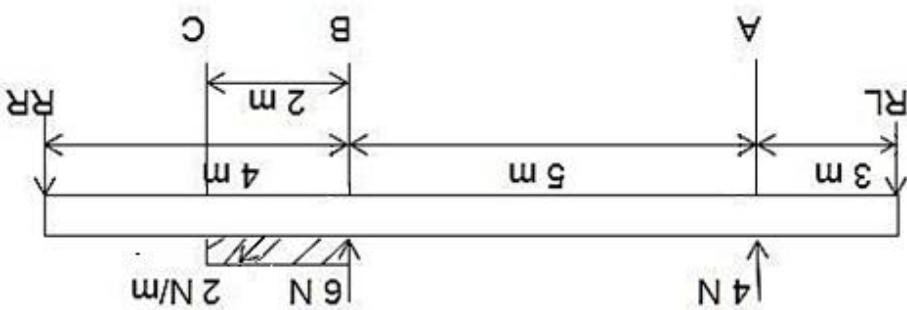
7.3.2 Die buigmomente by punt A, B en C

(3)

(4)

7.3.1 Die omvang van reaksies RL en RR

Bereken:



7.3

In Blak word aan twee puntlaste en een UVL onderwerp en word aan albei kante deur RL en RR gestuur.

(7)

Teken die spanning-vervormingdiagram en du al die belangrike punte op die grafiek aan.

7.2

(3)

7.1.4 Die verlenging van die staaf as gevolg van die krag

(2)

(3)

(3)

7.1.1 Die dwarsdeursnee-oppervlakte van die staaf

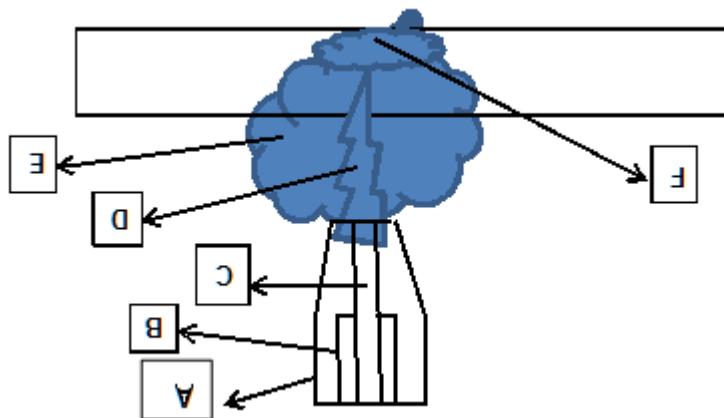
Bereken:

7.1 In trekspanning van 100 KN word op 'n ronde staaf toegepas. Die diameter van die staaf is 50 mm en die lengte is 10 m. Young se modulus vir hierdie staal is 200 GPa.

VRAAG 7: KRAGTE

[25]

(6)

FIGUUR 6.5

- 6.5 Identifiseer en bestempel die skeets van goeie die Mig-sweisproses soos aangeleui in die illustrasie (FIGUUR 6.5) hieronder.

- 6.4 Noem VYF moonlike defecte van sweislaaste by visuele inspeksie.

- 6.3 Verduidelik die prosedure van die ultrasoniiese toetsingmetode wat op h swesisas toegepas word.

| Defek | Oorsak | Regstelling | 6.2.4 ... | 6.2.5 ... | 6.2.6 ... |
|-------|--------|-------------|-----------|-----------|-----------|
| | | | 6.2.1 ... | 6.2.2 ... | 6.2.3 ... |

Tabuleer jou antwoord as volg:



6.2.4



6.2.1

- 6.1 Verduidelik die verskil tussen niedestruktyiewe en destruktyiewe toetses wat op swesisaste uitgevoer mag word.

- 6.2 Bestudeer die TWEE swesidefecte onder die hooftrekke hieronder en identifiseer h oorsak en h regstelling vir elk:

VRAAG 6: HETTINGMETHODES

[30]
(5)

- 5.5 Bereken die breedte van 'n spylleuf wat gesny moet word op 'n 50 mm ronde staaf en beskryf hoe 'n 20 mm wyd voorvalksnybeteil gesentreer moet word om die gleyf te sny.

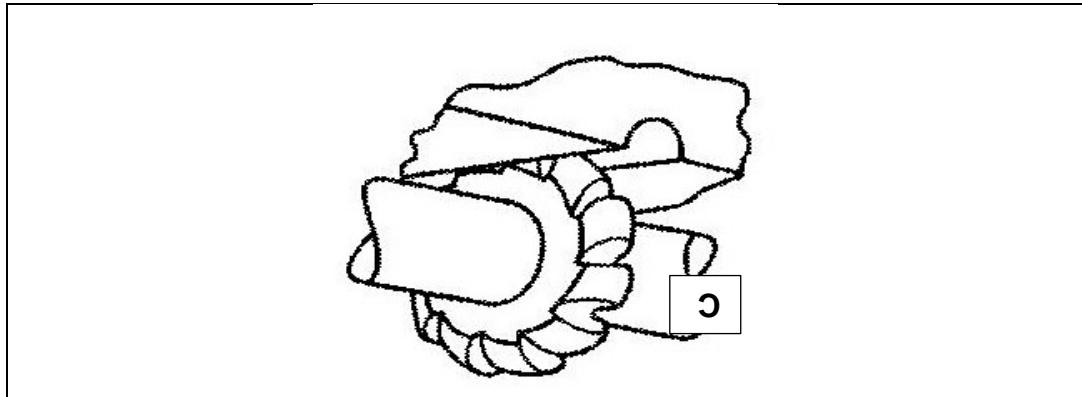
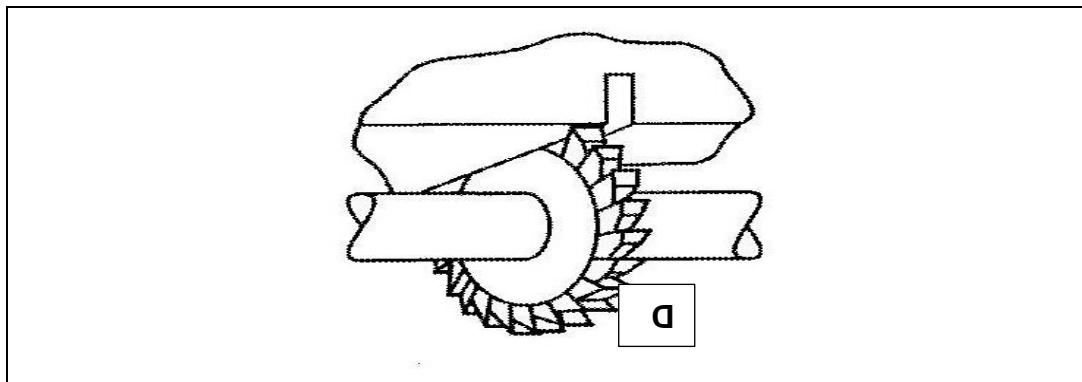
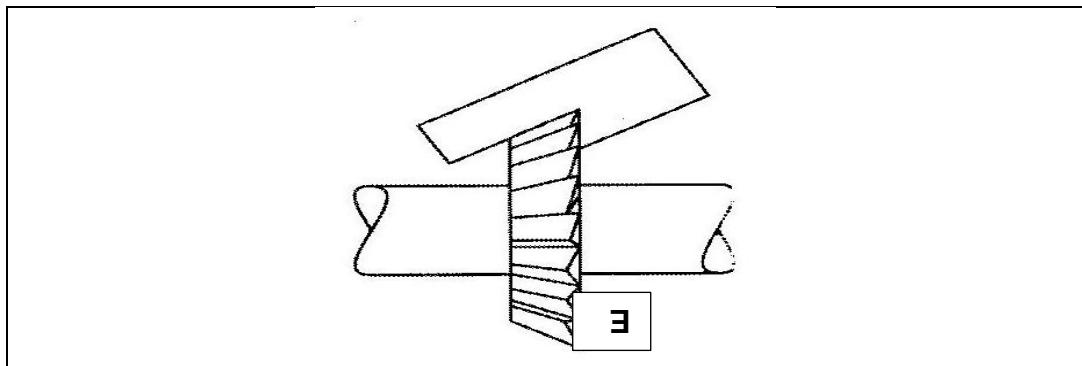
(4)

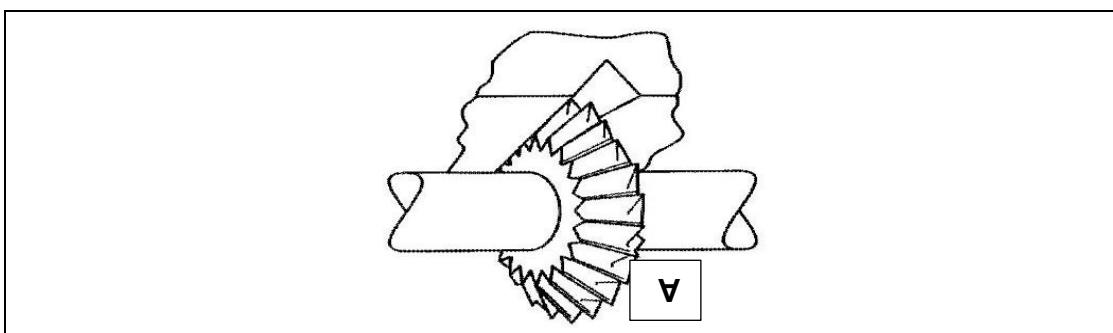
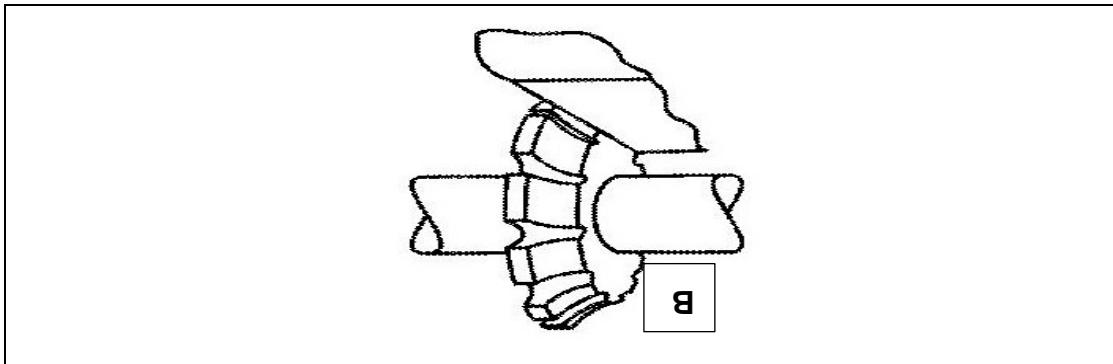
- 5.4 Bereken die indeksering wat benodig word om 32 tandé op die omtrek van 'n ronde staaf te sny.

(9)

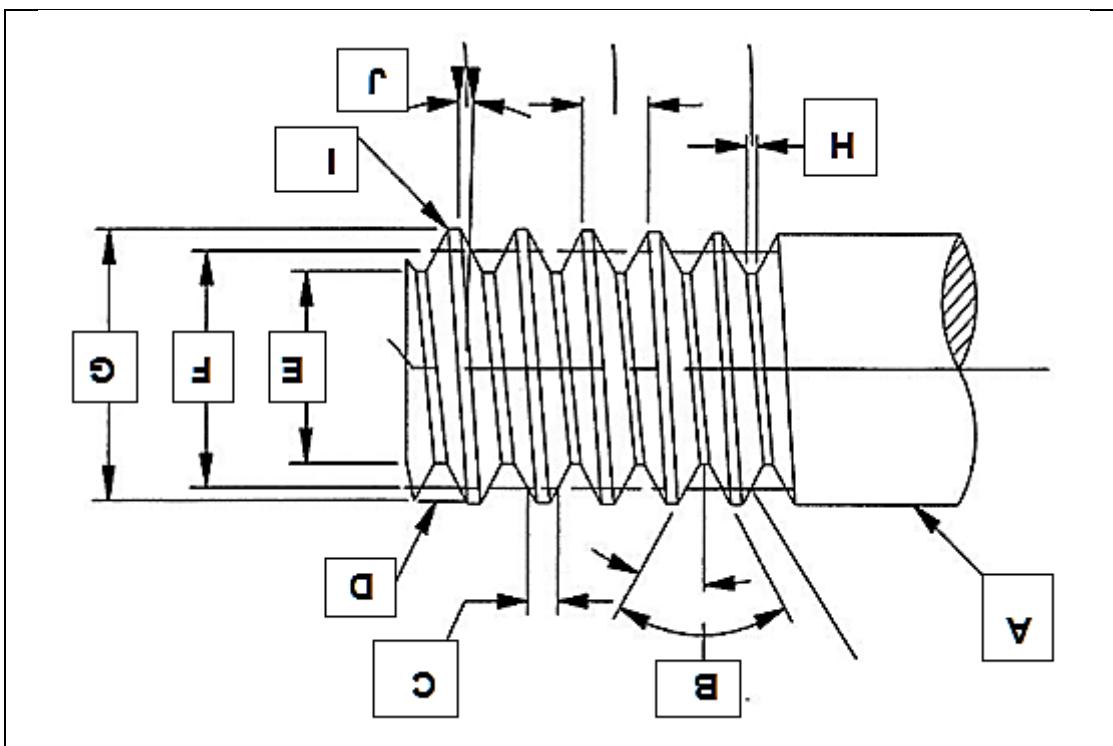
- 5.3 Teken die skeise om die verskillende tussen die opsnij- en afsnij-freeswerk te demonstreer.

(5)





5.2 Identifiseer die freesstyggers soos aangewes vanaf A-E in die sketsse wat volg.



5.1 Bestudeer die skroefdraad hieronder en identifiseer die dele A-J.

VRAAG 5: TERMINOLOGIE

[13]
(3)

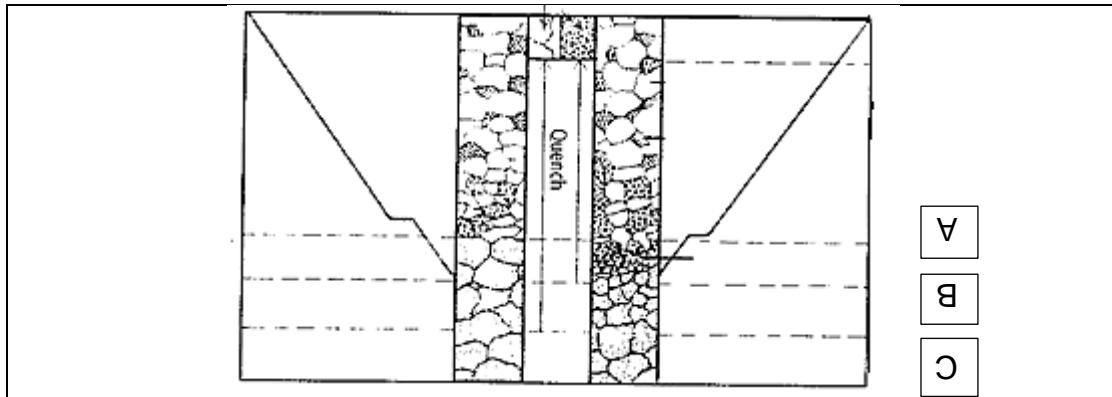
(3)

4.3.2 Temperatuur

4.3.1 Koolstofinhoud

4.3 Verduidelik die yster-koolstof diagram met verwysing tot die volgende:

FIGUUR 4.2



4.2 Bestudeer FIGUUR 4.2 hieronder en identifiseer die DRIE temperatuurpunte verkunderinge plaasvind, hite of afkoelings.

4.1 Meld enige VIER verskillende kristalstrukture wat op die yster-koolstof ekwilibriumdiagram aangedeui word.

3.1 Verduidelik die prosedure stap vir stap hoe 'n gasontleder aan 'n motor se uitlaatpyp gekoppel moet word om die CO_2 te toets om die gas te analiseer wat by die uitlaatpyp uitgeskei word.

3.2 Noem 'n funksie en 'n gebruik vir die volgende gereedskapskuuk wat gebriuk word in die werkswinkel soos in die kolom hieronder aangedui.

| Gereedskap | Funksie | Gebruik | Veerstoeter | 3.2.5 ... | 3.2.6 ... |
|--------------------------|-----------|-----------|---------------|-----------|-----------|
| Verkoelingstelselstoeter | 3.2.1 ... | 3.2.2 ... | Torsiestoeter | 3.2.3 ... | 3.2.4 ... |
| Gereedskapskuuk | | | | | |

VRAAG 4: MATERIAAL

[12]
(6)3.1 Verduidelik die prosedure stap vir stap hoe 'n gasontleder aan 'n motor se uitlaatpyp gekoppel moet word om die CO_2 te toets om die gas te analiseer wat by die uitlaatpyp uitgeskei word.

3.2 Noem 'n funksie en 'n gebruik vir die volgende gereedskapskuuk wat gebriuk word in die werkswinkel soos in die kolom hieronder aangedui.

VRAAG 3: GEREDSKAP

[10]

(1)

(1)

(1)

(1)

(1)

(4)

- 2.1 Noem enige VIER veiligheidsmaatreëls wat nagekom moet wanneer daar met h persmasjién gevrek word.
- 2.2 Verklaar of die volgende stellings WAAR of ONWAAR is:
- 2.2.1 Dit is die verantwoordelikheid van h leerling om onveilig/ongesond te staande in die werkplek te rapporteer.
 - 2.2.2 Gebruik altyd die korrekte moersleutel om die klem van h ratteker vas te trek.
 - 2.2.3 Die vlagslyper kan gebruik word sonder regte oë-beskerming.
 - 2.2.4 Dit is veilig om skerms te verset terwyl die kragsaag in werkning is.
- 2.3 Noem enige TWEE veilige besonderehede wat op die etiket van 'n gasylinder sigbaar moet wees.

VRAAG 2: VEILIGHED

Bestudeer FIGUUR 2.1 hieronder.

**FIGUUR 2.1**

[20]

(1)

- A Superaanjaer
B Dubbelaanjaer
C Stoomaanjaer
D Turboaanjaer



1.20 Identifiseer die aanjaer hieronder en kies die korrekte antwoord.

(1)

- A Die installeering verg uitgebreide wysiging van die uitlaatsleel.
B Moter luier voorrade dit afgeskakel word.
C Het nie h probleem van vertraging/sloering nie.
D Word deur enjinolie gesmeer.

1.19 Watte van die volgende is 'n voordeel van 'n superaanjaer in vergelyking met 'n turboaanjaer?

(1)

- A volume.
B vloeistof.
C las/krag.
D gas.

1.18 Hidroulika verwys na die oorbrenging en beheer van kragte en beweging deur middel van ...

(1)

- A Die volume van 'n gegewe massa is omgekeerd eweredig aan die druk daarop, indien die temperatuur konstant bly.
B Die verhouding tussen spanning en vormverandering in 'n metaal.
C Die traagheid van 'n liggaam om te beweeg.
D Inntreme krag in materiaal wat 'n sykrag kan weerhou.

1.17 Watte van die volgende verklarings definieer Boyle's se wet?

(1)

- A Ontvangs van data vanaf die enjin
B Ontvangs van data vanaf die elektroniese beheereenhied
C Ontvangs van data vanaf die vergasser
D Ontvangs van data vanaf die opgestelde sisteme

1.16 Wat is die funksie van die EBE in 'n motorvoertuig?

- 1.10 Watte van die volgende is 'n destruktiwe toets?
- (1)
- A Kleurstofindringingstoets
B X-stralatoets
C Kerfbuigtoets
D Ultrasoniestotoets
- 1.11 Watte tip trae-afskerwingsgas word in MIG-sweiswerk gebruik?
- (1)
- A Asitielen
B Suurstof
C CO₂ gemaeng met argon
D Stiksot
- 1.12 Dui die korrekte antwoord aan vir die afkorting UVL, met die berekening van momente in ingenieurskomponente.
- (1)
- A Uniforme dleperekraglas
B Universelle ontwerpplingslas
C Uniforme destruktiiewelaas
D Uniforme verspreidelas
- 1.13 Watte komponent is direk eweredig aan die dwarsdeursnee in oppervlakte van 'n liggaam?
- (1)
- A Vormverandering
B Young se modulus van elastisiteit
C Verandering in lengte
D Spanning
- 1.14 Die passasiervoertuig-motorolie (PVMO) moet verskeie funksies vervul, waaronder die meeeste inlyn is met die grondliggende beginse van die smeerstoel. Kies die VERKEERDE verklaring.
- (1)
- A Bewegende onderdele word geskei deur 'n smervlies tussen in te vorm.
B Anpakkels en silky word van enjinoppervlakte verwys na wat die vorming van vermis op die suier voorhom.
C Slytasse beperk in dele van die enjin waar laste hoog oor snelheid lê as die laagste temperatuur waar olie wasem afgee wat vlam kan vat?
D Die olie moet skuum en moet nie oksidaseie kan weehou nie.
- 1.15 Watte van die eienskappe van smeermiddels hieronder kan gedefinieer word
- (1)
- A Vloeipunt
B Flitspunt
C Viskositeit
D Grondpunt

(1)

- A Geowne freesbieteis
B Verspreide ratande
C Proflebieteis
D Woodruffsyfers

1.9 Watte EEN van die volgende is NIE 'n draadspilisnyer NIE?

(1)

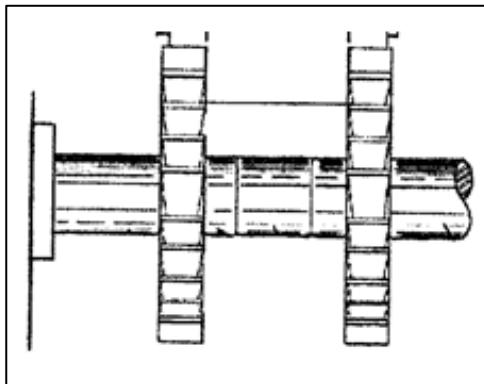
- A 5 volle draaie
B 8 volle draaie
C 12 volle draaie
D 4 volle draaie

1.8 Berken die getal draaie op 'n 5-tandrat met die gebruik van een vuudige indeksering op 'n verdeelkop.

(1)

- A Vlakfreeswerk
B Koppelfreeswerk
C Groep freeswerk
D Geesentraaliseerde freeswerk

FIGUUR 1.8



1.7 Identifiseer die freesmasjienwerksginsel, soos in FIGUUR 1.8 aangedui.

(1)

- A Verhitingspunt.
B Ontverhittingspunt.
C Laer kritiese punt.
D Hoer kritiese punt.

gedurende verhitting is die ...

1.6 Die temperatuur waar koolstofstaal van perilet na austeniet verander,

(1)

- A Krukas
B Klyptang
C Skroewedraaier
D Klinknaleis

1.5 Watte EEN van die volgende is NIE 'n gebruik vir medium koolstofstaal NIE
(0,25-0,55%)?

(1)

- A Diepte-mikrometer
- B Skroefdraad-mikrometer
- C Binne-mikrometer
- D Buite-mikrometer

1.4 Wattet EEN van die volgende word gebruik om die stekderusnit te meet?

(1)

- A Drukversteller
- B Drukontlastsklep
- C Drukmetier
- D Vonkproppassstuks

Watter een is NIE geskik nie?



1.3 Een van die volgende komponente is NIE deel van 'n kompressiestootser NIE.

(1)

- A Beskermede kleredrag, sowel as oogbeskerming is noodsaaklik.
- B Neem waar of die gereedskapsuit nie meer as drie (3) mm van die slypwyel is nie.
- C Verstan al die werksgesels met betrekking tot die massien.
- D Mak seker dat alle skerms en veiligheidmeganismes in plek is.

1.2 Veiligheidmaatreëls moet gehandhaaf word met die gebruik van die vlagslypers. Wattet een is NIE geskik nie?

(1)

- A Gedruis/Geraas
- B Beligting
- C Rowwe spelery
- D Radiasie

1.1 Wattet EEN van die volgende is NIE 'n omgewingsrisiko Nie?

1.1-1.20) in die ANTWOORDEBOEK te trek, bv. 1.21 B.
die korekte antwoord deur 'n kruis (X)oor die letter (A-D) langs die vragnommer
Verskeie opsigte word as moontlike antwoorde vir die volgende vrae voorsien. Kies

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

| VRAG | ONDERRWERP GEDEK | PUNTE | TYD | TOTAL: | 180 minute |
|------|--|-------|-------------------------------------|--------|---|
| 1. | Skryf jou naam en van in die betrokke spasies wat op jou ANTWOORDEBOEK verskaf word. | 2. | Beantwoord AL die vrae. | 3. | Bestudeer alle vrae deeglik. |
| 4. | Nommer die antwoordekorrekte volgens die nommeringstelesel wat in hierdie vraestelle gevra word. | 5. | Skryf duidelik en leesbaar. | 6. | Toon ALLE berkeninge en eenhede. Ronde finale antwoordes af na TWEEDESIMALE plekke. |
| 7. | Kandidate mag nieprogrammeerbare, wetenskaplike sakrekenaars, asook teken-/wiskundige instrumente gebruik. | 8. | Begin ELKE vraag op 'n NUWE bladsy. | 9. | Gebruik die onderstannde kriteria om jou te help met die beplanning van jou tyd: |
| | | | | | |

1. Skryf jou naam en van in die betrokke spasies wat op jou ANTWOORDEBOEK verskaf word.
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INSTRUKSIES EN INLIGTING

Hierdie vraestel bestaan uit 21 bladsye, insluitend een formulieblad.



TYD: 3 uur

PUNTE: 200

MEGANIESE TEGNOLOGIE

SEPTEMBER 2014

GRAAD 12

SENIOR SERTIFIKAAT
NASIONALE

EDUCATION
PROVINCE OF THE
EASTERN CAPE

