



Province of the  
**EASTERN CAPE**  
EDUCATION

## NATIONAL SENIOR CERTIFICATE

**GRADE 12**

**SEPTEMBER 2013**

### MECHANICAL TECHNOLOGY

**MARKS:**      **200**

**TIME:**      **3 hours**



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This paper consists of 22 pages including an answer sheet and 4-page formula sheet.

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**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 and answer according to the numbering system used in the questions.
5. Write neatly and legibly.
6. Show all calculations and units.
7. Candidates may use non-programmable scientific calculators and drawing/mathematical instruments.
8. The value of the gravitational force should be taken as  $10 \text{ m/s}^2$ .
9. Use the criteria below to assist you in managing your time.

Question	Assessment Standards	Concepts covered	Marks	Time
1	1 – 9	Multiple-choice questions	20	18 minutes
2	6 and 8	Forces, Systems and Control	50	45 minutes
3	2	Tools and equipment	20	18 minutes
4	3	Materials	20	18 minutes
5	1, 4 and 5	Safety, Terminology and Joining methods	50	45 minutes
6	7 and 9	Turbines and maintenance	40	36 minutes
<b>Total</b>			<b>200</b>	<b>180 minutes</b>

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

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

EXAMPLE: 1.21 

1.21	X A	B	C	D
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1.1 Bronze is an alloy of which non-ferrous metals?

- A Copper and Zinc
- B Tin and Copper
- C Tin and Lead
- D Zinc and Lead

(1)

1.2 Identify the polymer that will be used to manufacture water bottle caps.

- A Polystyrene
- B Polyvinyl Chloride
- C Polypropylene
- D Polyethylene terephalate

(1)

1.3 The function of the tensile tester is to determine the ... of a metal.

- A percentage elongation
- B hardness
- C torque
- D internal stress

(1)

1.4 The Vickers hardness test indenter is made from which material?

- A Hardened steel-ball
- B Carbide ball
- C Diamond
- D Cobalt

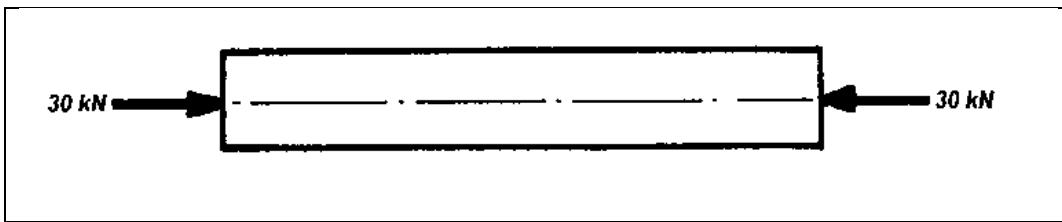
(1)

1.5 The dividing head's ratio is ...

- A 1 : 40.
- B 20 : 1.
- C 1 : 80.
- D 40 : 1.

(1)

- 1.6 Calculate the compressive stress in a 15 mm round brass bar if subjected to a 30 kN compressive load.



A 169,77 MPa

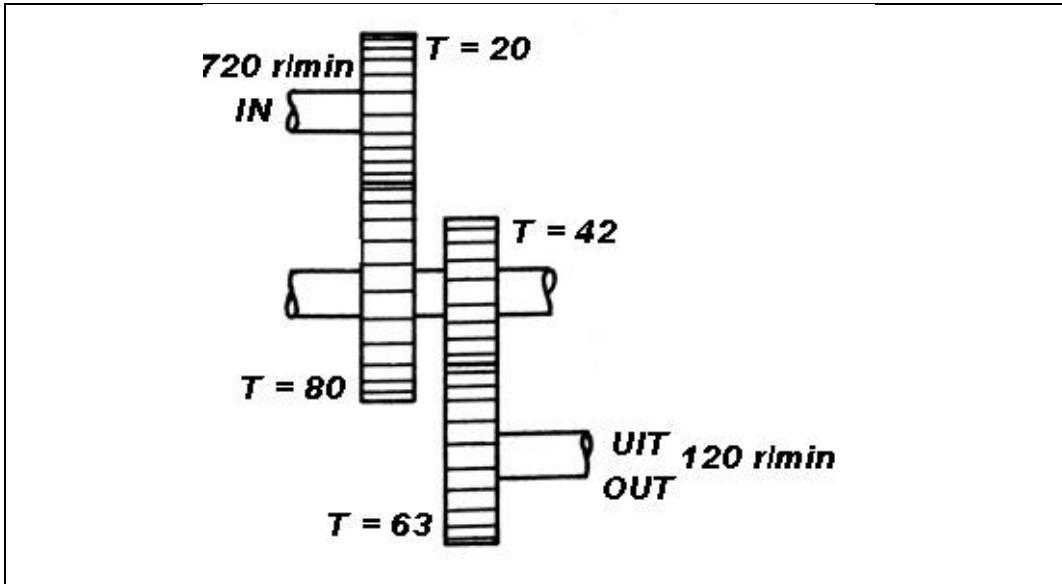
B 169,77 kPa

C 159,15 MPa

D 159,15 Pa

(1)

- 1.7 Calculate the speed ratio of the compound gear drive in the figure below.



A 1 : 6

B 1 : 7

C 6 : 1

D 7 : 1

(1)

- 1.8 A centrifugal turbocharger is driven by ...

A exhaust gases.

B steam.

C mechanical drive.

D alternator.

(1)

1.9 Identify the milling cutter shown in FIGURE 1.9 below.

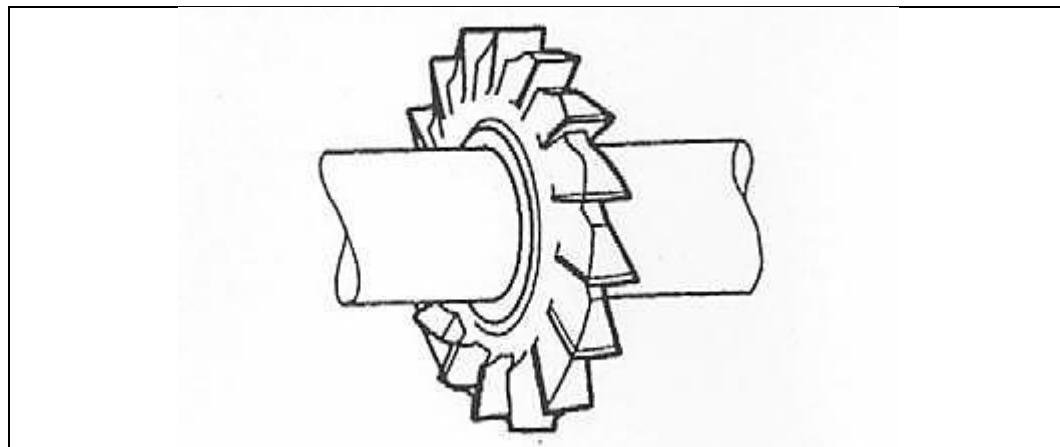


FIGURE 1.9

- A Double equal angle milling cutter
- B Side and face milling cutter
- C Convex milling cutter
- D Nicked helical cutter

(1)

1.10 What does the acronym **SAE** annotate in terms of lubricating oil?

- A "Society of Automotive Engineers"
- B "South African Engineers"
- C "South American Engineers"
- D "Society of American Engineers"

(1)

1.11 The purpose of the oil pump in a motor vehicle is to ...

- A reduce heat loss.
- B clean the oil from impurities.
- C regulate the oil temperature.
- D circulate the oil under pressure.

(1)

1.12 Which of the following safety precautions should be kept in mind when arc welding is performed to prevent a possible fire that can be caused by flying sparks?

- A Welder is insulated by means of gloves
- B Workplace must be partitioned off
- C Remove flammable materials from welding area
- D Keep cables and tools organised

(1)

1.13 Complete the sentence by filling in the missing word.

MIG welding machines are ... current welding machines?

- A direct
- B alternating
- C single phase
- D three-phase

(1)

1.14 What is the reason for using visual examination in testing of welds?

- A To check for the size of the weld
- B To approve welders and welds to certain standards
- C To train welders
- D To test the skill of the welder

(1)

1.15 Analyse under what type of stress the rivets are subjected to as shown in FIGURE 1.15.

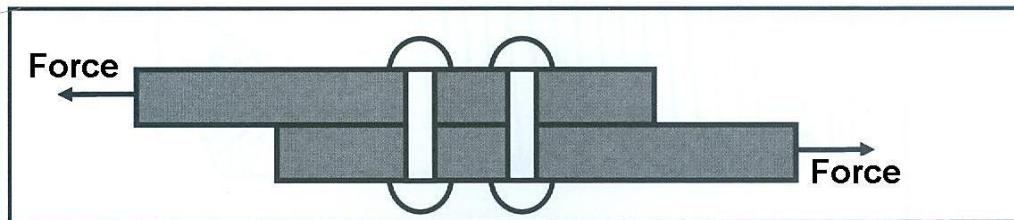


FIGURE 1.15

- A Shear stress
- B Tensile stress
- C Compressive stress
- D Pushing stress

(1)

1.16 Cutting fluids is used during machining processes to ...

- A cool the cuttings.
- B cool the work station.
- C cool the machine.
- D cool the work piece and tool.

(1)

1.17 A three start Acme screw thread has a pitch of 9 mm. The lathe which is used to cut the thread has a lead screw of 5 mm pitch. What will the lead of the screw thread be?

- A 27 mm
- B 5 mm
- C 15 mm
- D 9 mm

(1)

1.18 Complete the sentence by filling in the missing word.

The lever in the figure is a ... lever.

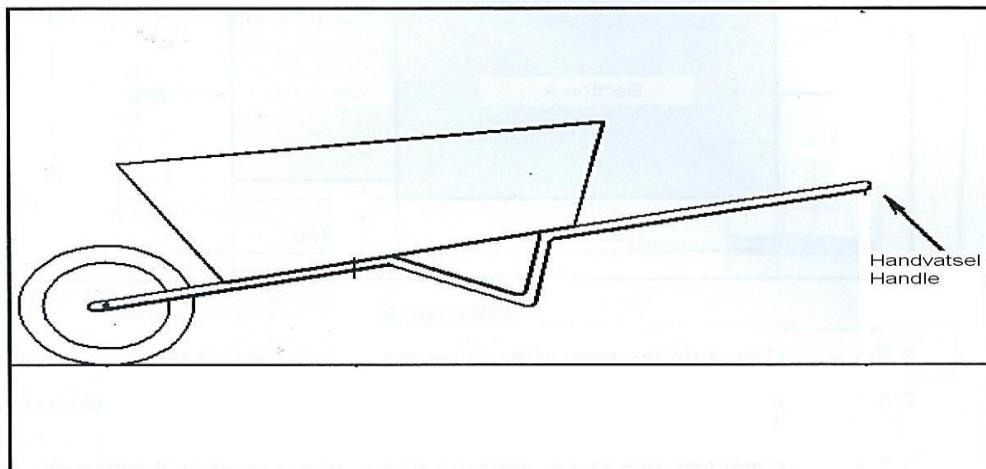


FIGURE 1.18

- A First order
- B Second order
- C Third order
- D Fourth order

(1)

1.19 Any hydraulic fluid is not compressible and therefore in a hydraulic system it will transfer force directly. Analyse the statements below and indicate which statement is not true for a hydraulic system.

- A The pressure is uniform throughout the system.
- B Volume is directly proportional to pressure.
- C Hydraulics is used to obtain mechanical advantage.
- D Hydraulics systems must have pressure relief safety valves.

(1)

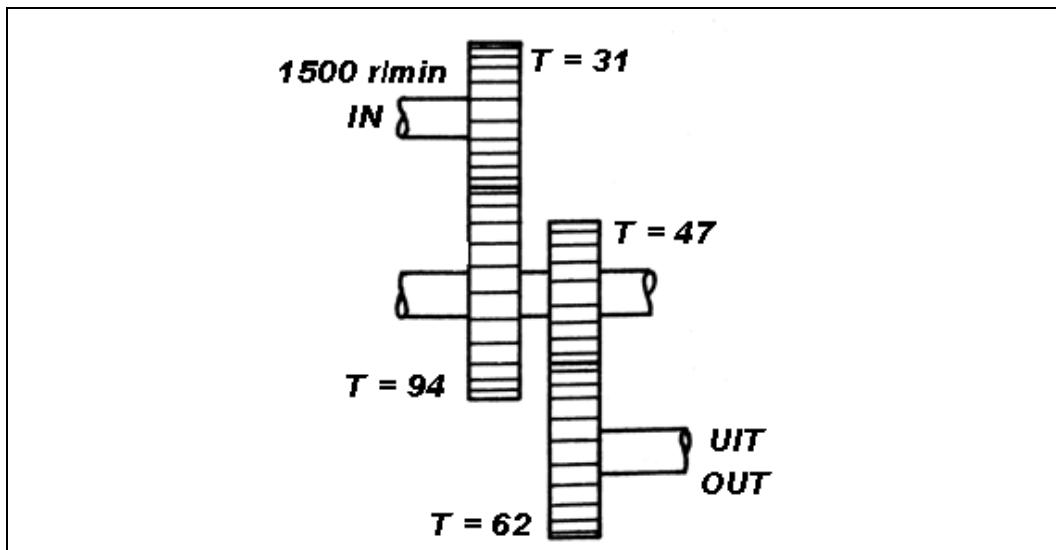
1.20 The concept lag and boost are only applicable to:

- A 8 m
- B 6 m
- C 4 m
- D 2 m

(1)  
[20]

## QUESTION 2: FORCES, SYSTEMS AND CONTROL

- 2.1 A steel rod, 20 mm diameter, is subjected to a tensile force of 17 kN. The steel rod will break if the maximum load of 85 kN is exceeded. Calculate:
- 2.1.1 The safety factor (2)
  - 2.1.2 The stress created in the rod (2)
- 2.2 A mechanical engineer must design a gear drive for a tool making machine as seen in the figure below. The input shaft dissipates 5 kW at 1 500 r/min. Calculate:



**FIGURE 2.2**

- 2.2.1 The gear ratio (2)
  - 2.2.2 The output speed (2)
  - 2.2.3 The output torque (3)
- 2.3 A helical gear must have 48 teeth with a normal module of 5 mm. The helical angle is  $28^\circ$ . Calculate:
- 2.3.1 The P.C.D. of the gear (4)
  - 2.3.2 The addendum (2)
  - 2.3.3 The dedendum (2)
  - 2.3.4 The full depth (2)
  - 2.3.5 The clearance (2)

- 2.4 A force of 100 N is applied on piston A of a hydraulic press. The diameter of piston A is 150 mm and piston B is 750 mm.

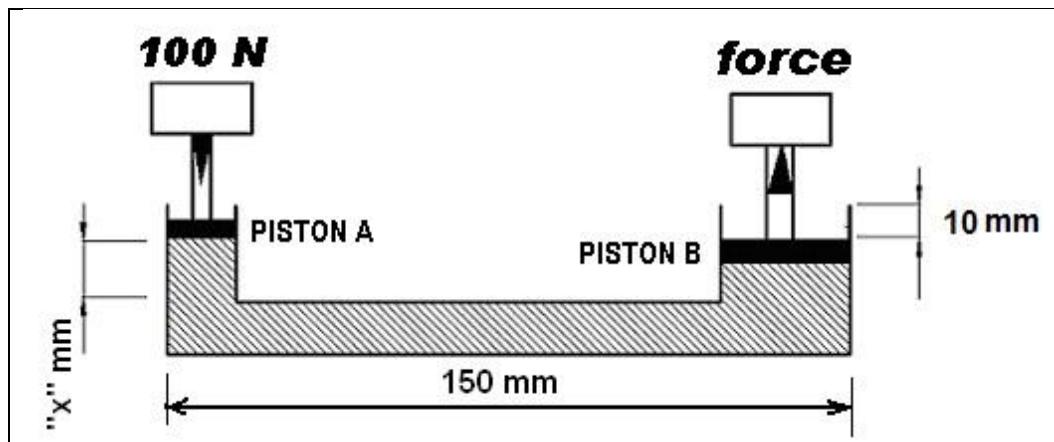


FIGURE 2.4

- 2.4.1 Calculate the force exerted by piston B. (3)
- 2.4.2 Calculate the distance in millimeters that piston A has moved downwards. (3)
- 2.4.3 If the distance of 150 mm is increased to 300 mm, what effect will it have on the pressure of the system? (1)
- 2.5 A three start square thread with a lead of 12 mm must be cut on a 50 mm diameter shaft. The clearance angle is  $3^\circ$ . Calculate the leading angle and the following angle of the cutting tool. (8)

- 2.6 A differential wheel and axle lifting machine has a mechanical advantage of 4. A workpiece of 135 kg must be lifted.

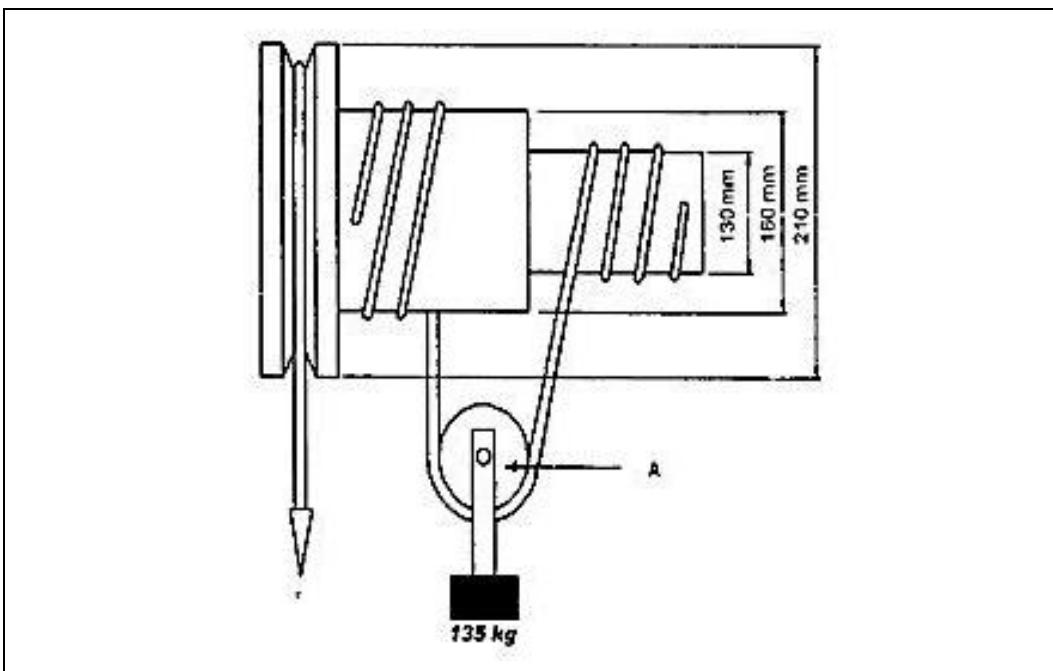


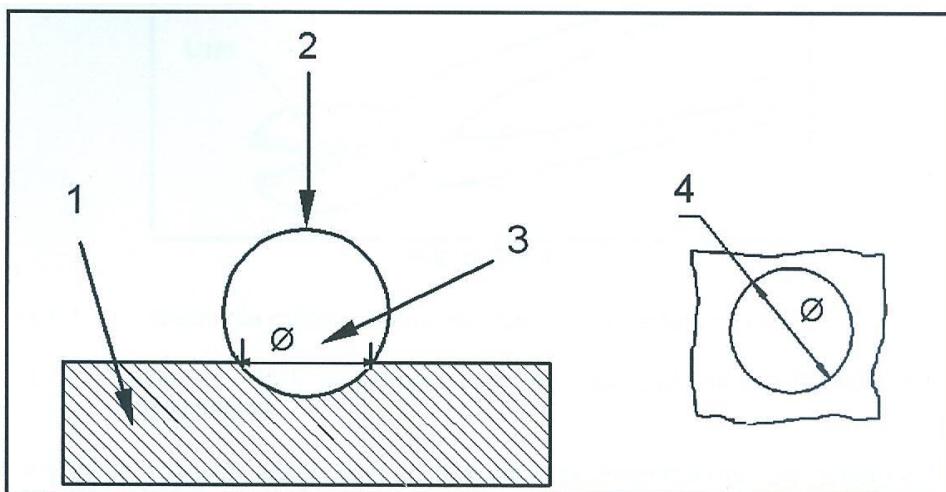
FIGURE 2.6

Calculate:

- 2.6.1 Effort applied (2)
- 2.6.2 Velocity ratio (2)
- 2.6.3 Mechanical efficiency (2)
- 2.7 A single plate friction clutch has an effective diameter of 0,28 m. The clutch plate has friction material on both sides with a friction co-efficient of 0,36. The total applied force on the pressure plate is 4 kN. Calculate and name the correct units for the following:
- 2.7.1 The maximum torque that can be transmitted (3)
- 2.7.2 The power transmitted at 3 700 r/min in kW (3)
- [50]

**QUESTION 3: TOOLS AND EQUIPMENT**

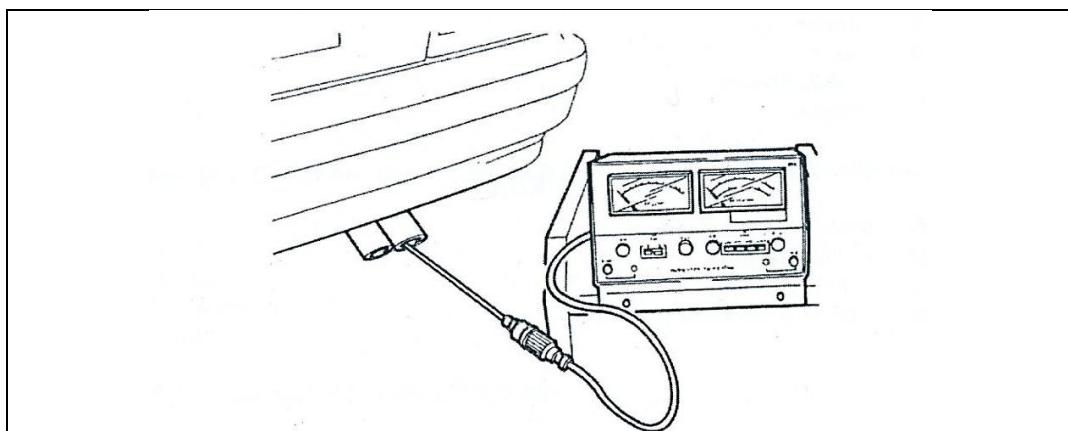
- 3.1 Michael uses the Brinell hardness tester to test the test piece given to him by his instructor. The figure below shows the test piece under the test. **Label** the figure according to the numbers on the figure.



(4)

**FIGURE 3.1**

- 3.2 **Identify** the diagnostic equipment shown in the figure.



(1)

**FIGURE 3.2**

- 3.3 After completing the gas analysing test, the machine indicated a high hydrocarbon reading. Give **FOUR** reasons for a high hydrocarbon reading. (4)
- 3.4 The tensile tester is designed to determine three functions when testing a piece of material. Name the **THREE** functions. (3)
- 3.5 What does the abbreviation MAGS/MIGS stand for in terms of welding equipment? (2)
- 3.6 Name **TWO** gases that can be used in MAGS/MIGS welding. (2)
- 3.7 Give **FOUR** possible findings when doing a cylinder leakage test on an engine. (4)

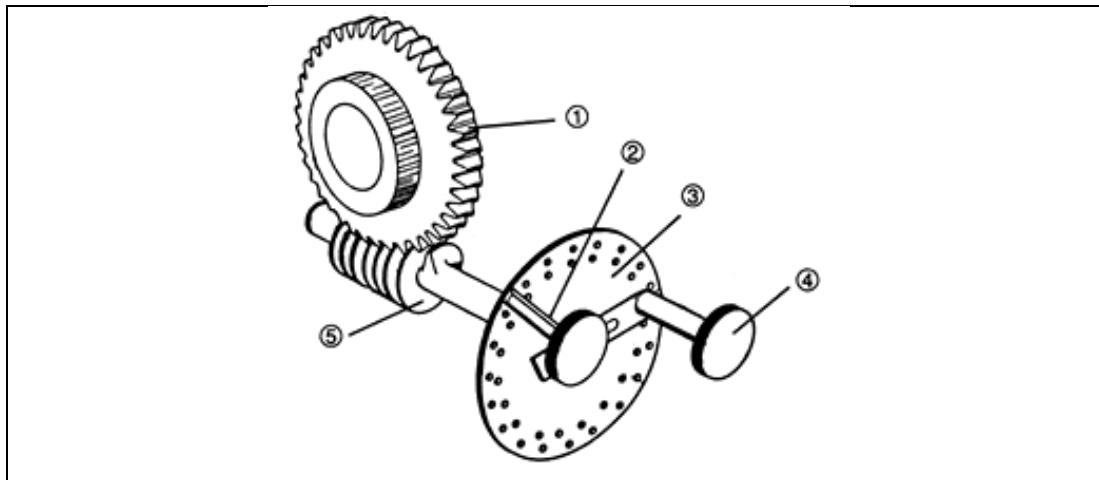
**[20]**

**QUESTION 4: MATERIALS**

- 4.1 Pure metals are generally soft and relatively weak. As soon as other metals or non-metals are added to them, their properties improve.
- 4.1.1 When adding antimony to the metal, it increases the alloy's ... . (Fill in the missing word.) (1)
- 4.1.2 Alloys on the one hand are created to be a harder, tougher metal. Name any FOUR other reasons for the creation of alloys. (4)
- 4.2 Name THREE reasons why aluminium is used to make kitchen utensils as well as marine vessels. (3)
- 4.3 Name THREE advantages and THREE disadvantages of thermoplastics over thermosetting plastics. (6)
- 4.4 Solder is an alloy of ... .(Fill in the missing word.) (2)
- 4.5 Carbon fibre is a very popular material in the sport equipment. Name TWO reasons why racing-bicycles frames are made from this material. (2)
- 4.6 Define a non-ferrous alloy and give ONE example. (2)
- [20]**

**QUESTION 5: SAFETY, TERMINOLOGY AND JOINING METHODS**

- 5.1 Write down THREE safety precautions to be observed when using a torsion tester. (3)
- 5.2 Dino is busy cutting a length of 125 mm from a 50 mm diameter "POM C" bar. Name FOUR safety precautions applicable when working on a power saw. (4)
- 5.3 Calculate the indexing in each of the following cases:
- 5.3.1 A gear with 19 teeth (3)
- 5.3.2 An angle of  $11^\circ 40'$  (4)
- 5.4 Differential indexing for 61 teeth. (Use 60 divisions) Determine the following:
- 5.4.1 The indexing (3)
- 5.4.2 The gears required (5)
- 5.4.3 The direction of rotation of the index plate (1)
- 5.5 Make TWO neat sketches to indicate the difference between up cut milling and down cut milling. Indicate the direction of rotation. (4)
- 5.6 FIGURE 5.6 shows the functioning components of the dividing head. Label the components numbered 1 – 5.

**FIGURE 5.6**

(5)

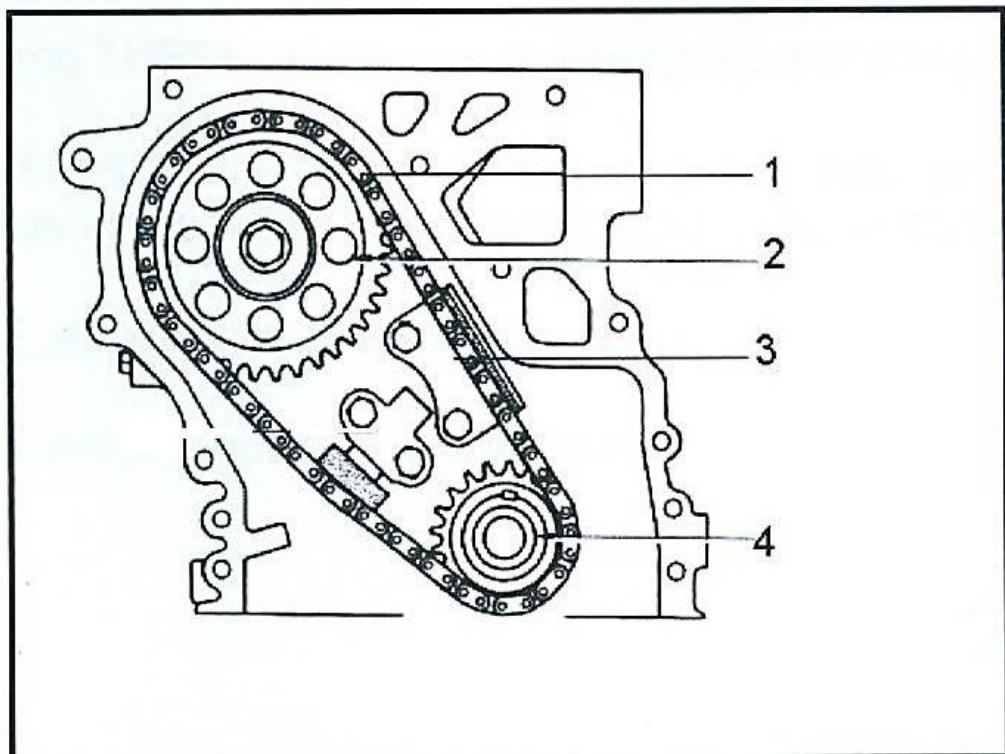
- 5.7 Devon, a welding joint inspector, is busy to perform welding quality tests.
- 5.7.1 Name TWO reasons for porosity in a welding joint. (2)
- 5.7.2 Name ONE step to follow to prevent porosity in a welding joint. (1)
- 5.7.3 Name TWO reasons for a lack of fusion in a welding joint. (2)
- 5.7.4 Devon uses the liquid dye penetrant test. Explain how this procedure will be carried out on the welding joint. (7)
- 5.8 Determine by means of calculations the feed in millimetre per minute of a 120 mm diameter milling cutter with 40 teeth, operating at a cutting speed of 85 meters per minute and a feed of 0,01 mm per tooth. (6)  
[50]

**QUESTION 6: TURBINES AND MAINTENANCE**

- 6.1 A long lifespan for gears is possible if the oil is regularly changed. The differential oil of your school's tractor must be drained and filled with new oil. Describe step-by-step how you would go about in changing the differential oil of the tractor. (8)
- 6.2 Good lubricating oil has different properties. Viscosity is one property. Define the term *viscosity*. (2)
- 6.3 State THREE properties of grease. (3)
- 6.4 Match the oil products in COLUMN B to the description in COLUMN A by writing the selected letter next to the number in COLUMN A, for example 6.4.4 D.

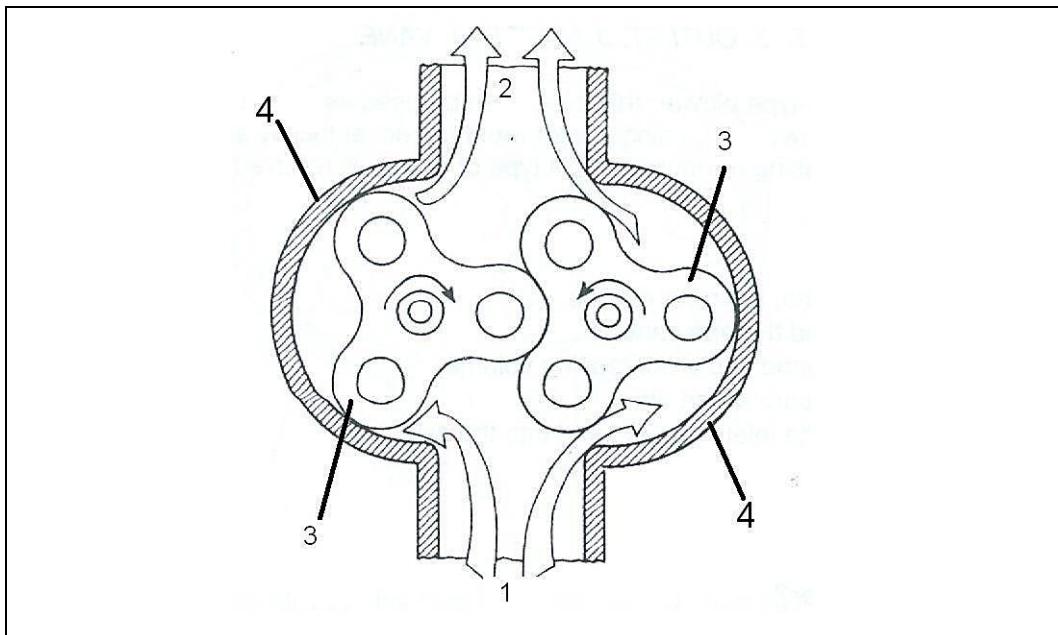
<b>COLUMN A</b>	<b>COLUMN B</b>	
6.4.1 Four stroke petrol engine	A EP 90	(1)
6.4.2 Motor gearbox	B SAE 75W90	(1)
6.4.3 Bakkie differential	C SAE 20W50	(1)

- 6.5 Timing chains play an important role in an engine. Given below is a sectional view of an engine with a timing chain. Label the parts in the sketch marked 1 – 4.



(4)

- 6.6 You are going to participate in a drag race tournament. Your Datsun 1400 bakkie's performance can be enhanced drastically by using a super-charger. The figure shows a type of supercharger you could use.



- 6.6.1 Label the parts numbered 1 to 4. (4)
- 6.6.2 State TWO advantages of using a supercharger. (2)
- 6.6.3 State TWO disadvantages of using a supercharger. (2)
- 6.7 State TWO advantages of a steam turbine and TWO advantages of a gas turbine. (4)
- 6.8 The tyres of a vehicle are subjected to wear. Wrong wheel alignment leads to excessive tyre wear and steering or tracking problems. Name THREE pre-checks that need to be carried out before wheel alignment test can be performed. (3)
- 6.9 Describe the basic operation of a steam turbine. (5)  
**[40]**

**TOTAL: 200**



**MECHANICAL TECHNOLOGY: ANSWER SHEET****GRADE 12****QUESTION 1** is to be answered on THIS ANSWER SHEET.**GRADE 12:** \_\_\_\_\_ **NAME:** \_\_\_\_\_

Indicate the correct answer with a cross (X).

Example: 1.21 

A	B	C	D
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**ANSWER SHEET**

QUESTION		1	(MULTIPLE-CHOICE QUESTIONS)	
1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D
1.16	A	B	C	D
1.17	A	B	C	D
1.18	A	B	C	D
1.19	A	B	C	D
1.20	A	B	C	D
TOTAL		<input type="text"/>		

Tear off and submit with answer book.

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

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

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

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

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

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

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

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

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

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

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

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

**2. FRICTION CLUTCHES**

$$2.1 \quad \text{Torque (T)} = \mu W n R$$

$\mu$  = 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 Stress =  $\frac{Force}{Area}$  or ( $\sigma = \frac{F}{A}$ )

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

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

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 Volume = Cross-sectional area x stroke length (l or s)

4.3 Volume liquid displaced by plunger = volume liquid displaced by ram

4.4 Volume = Area  $\times$  stroke length

### 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. GEAR DRIVES SPUR GEAR

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

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

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

7.4 Torque = force  $\times$  radius

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

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

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

7.8 Outside diameter (OD) = PCD + 2 module      or      OD = m(T + 2)

7.9 Addendum (a) = module (m)

7.10 Dedendum (b) = 1,157 m      or      Dedendum (b) = 1,25 m

7.11 Cutting depth (h) = 2,157 m      or      Cutting depth (h) = 2,25 m

7.12 Clearance (c) = 0,157 m      or      Clearance (c) = 0,25 m

7.13 Circular pitch =  $\pi \times m$

7.14 Work depth = 2  $\times$  add      or      work depth = 2  $\times$  m

## 8. HELICAL GEAR

8.1 Pitch circle diameter:  $PCD = T \times m_r$

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

8.3 Dedendum = 1,157  $m_n$

8.4 Clearance = 0,157  $m_n$

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

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

8.7 (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:  $\theta$

$$\tan \theta = \frac{\pi \times PCD}{\text{Lead of work piece}}$$

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 x pitch)

9.2 Lead = pitch  $\times$  number of starts

9.3 Helix angle :  $\theta$

$$\tan \theta = \frac{\text{lead}}{\pi \times D_e}$$

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 =  $3^\circ$  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 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 Cutting speed ( $V$ ) =  $\pi \times D \times N$

Where  $D$  = diameter of the cutter in metres

**10. VERDEELKOPTABEL VIR DIE FREESMASJIEEN**

GATSTRIKELS									
STANDARDWISSELRATE									
Sy 1	24	25	28	30	34	37	38	39	41
Sy 2	46	47	49	51	53	54	57	58	59

24 x 2	28	32	40	44	48	56	64	72	86	100
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**11.1 Toevoer ( $f$ ) =  $f_1 \times T \times N$** 

Waar  $f$  = toevoer in millimeter per minuut  
 $N$  = aantal omwentelinge van die snijer per minuut  
 $T$  = aantal tande van die snijer

$f_1$  = toevoer in tand per millimeter

Waar  $f_1$  = toevoer in millimeter per minuut

**11. BEREKENINGE TEN OPSIGTE VAN TOEVOER****10.3 Hoeek ind =  $\frac{\text{hoeek in minute}}{540}$** 

Waarselrate:  $\frac{Dn}{Dr} = \frac{A}{(A-n)} \times \frac{40}{40}$  of  $\frac{Gd}{Dr} = \frac{A}{(A-n)} \times \frac{1}{40}$

Eenvoudige indekserieing =  $\frac{n}{40}$  (waar n = getal indekselings)

**10. VERDEELKOPTABEL VIR DIE FREESMASJIEEN**

## 8. HELLESE TANDRATTE

- 8.1 Steeksirkeldiameter  $SSD = T \times m_w$
- 8.2 Addendum ( $a$ ) = module ( $m_w$ )
- 8.3 Dedendum =  $1,157 m_w$
- 8.4 Vryruimte =  $0,157 m_w$
- 8.5 Buitediameter ( $BD$ ) =  $SSD + 2 \text{ addendum}$
- 8.6  $T = \frac{m_w}{SSD}$
- 8.7 (Normale module)  $m_n$  = (werklike module)  $m_w \cos \theta$
- 8.8 Getal tandde gemerk op die freesstryk:  $N_r = \frac{(cos\theta)^3}{T}$
- 8.9 Helikschoek:  $\theta = \frac{\text{stygning van werksruk}}{\pi \times SSD}$
- 8.10 Stygning van werksruk =  $\frac{TAN \theta}{\pi \times SSD}$
- 8.11 Lei of stygning van freesmasjién = verdeelkopverhouding  $\times$  leiskroefsteek
- 8.12 Wisselrate benodig:  $\frac{Dr}{Dn} = \frac{\text{stygning van masjién}}{\text{stygning van werksruk (rat)}$
- 8.13 Sirkelsteek =  $\pi \times m_w^2$
- 8.14 Die freesmasjién het 'n tafelleiskroef met 'n 6 mm steek tensy anders vermeld.

## 9. SKROEFDRADE

$$\text{TAN } \theta = \frac{\pi \times D_w}{\text{stygning}}$$

9.3 Helikschoek :  $\theta$

9.2 Stygning = steek  $\times$  aantal beginne

9.1 Steekdiameter ( $D_w$ ) =  $BD - (0,5 \times \text{steek})$

9.6 Vryloophoek =  $3^\circ$  tensy anders vermeld

9.5 Sleephoek =  $90^\circ + (\text{helikschoek} - \text{vryloophoek})$

9.4 Ingryphoek =  $90^\circ - (\text{helikschoek} + \text{vryloophoek})$

## 7. RATIANDRYWINGS REGULITANDRAT

- 7.1  $Drywing (P) = \frac{60}{2\pi NT}$
- 7.2  $Ratverhouding = \frac{produk van die aantal tande op gedrewe rate}{produk van die aantal tande op dryfrate}$
- 7.3  $N_{inset} = \frac{N_{uitset}}{produk van die aantal tande op die gedrewe rate}$   
produk van die aantal tande op dryfrate
- 7.4  $Wringkrag = krag \times radius$
- 7.5  $Wringkrag oorgedra = ratverhouding \times insetwringkrag$
- 7.6  $Module (m) = \frac{steeksirkeldiameter (ssd)}{getal tande (T)}$
- 7.7  $Steeksirkeldiameter (SSD) = \frac{striklesteek (SS) \times aantaltanede(T)}{n}$  of  $SSD = T \times m$
- 7.8  $Buiteidiameter (BD) = SSD + 2 \text{ module}$  of  $BD = m(T + 2)$
- 7.9  $Addendum (a) = module (m)$
- 7.10  $Dedendum (b) = 1,157 \text{ m}$  of  $Dedendum (b) = 1,25 \text{ m}$
- 7.11  $Snydipepte (h) = 2,157 \text{ m}$  of  $Snydipepte (h) = 2,25 \text{ m}$
- 7.12  $Vryruimte (c) = 0,157 \text{ m}$  of  $Vryruimte (c) = 0,25 \text{ m}$
- 7.13  $Sirkelsteek = \pi \times m$
- 7.14  $Werkdipepte = 2 \times add$  of  $werkdipepte = 2 \times m$

	<b>3. SPANNING EN VORMVERANDERING</b>
3.1	$\text{Spanning} = \frac{\text{Opperlaakte}}{\text{Krag}} \text{ of } (\sigma = \frac{F}{A})$
3.2	$\text{Vormverandering} (\epsilon) = \frac{\text{veranderende lengte (AL)}}{\text{oorspronkelijke lengte (AL)}}$
3.3	$\text{Young se modulles (E)} = \frac{\text{spanning}}{\text{oormverandering of } (\epsilon)}$
3.4	$A_{as} = \frac{4}{\pi D^2}$
3.5	$A_{pyp} = \frac{4}{\pi(D^2 - d^2)}$
4.	<b>HIDROULIKA</b>
4.1	$\text{Druk (P)} = \frac{\text{opperlaakte (A)}}{\text{krag (F)}}$
4.2	$\text{Volume} = \text{Dwarsdeursnee} \times \text{slaglengte (l of s)}$
4.3	$\text{Volume vloeistof deur plunjier verplaas} = \text{volume vloeistof deur ram verplaas}$
4.4	$\text{Volume} = \text{oppervlakte} \times \text{slaglengte}$
5.	<b>WIEL EN AS</b>
5.1	$\text{Snelheidsvrehouding (VR)} = \frac{\text{hydraagafstand}}{\text{hydraagafstand}} = \frac{d^2 - d^1}{2D}$
5.2	$\text{Meganiese voordeel (MA)} = \frac{\text{hydraag (F)}}{\text{las (W)}}$
5.3	$\text{Meganiese effektiwiteit (n_meg)} = \frac{VR}{MA} \times 100\%$
6.	<b>HEFBOME</b>
6.1	$\text{Meganiese voordeel (MA)} = \frac{\text{hydraag (F)}}{\text{las (W)}}$
6.2	$\text{Insetbeweging (IM)} = \text{Hydraag} \times \text{afstand beweging deur hydraag}$
6.3	$\text{Uitsetbeweging (OM)} = \text{las} \times \text{afstand beweging deur las}$
6.4	$\text{Snelheidsvrehouding (VR)} = \frac{\text{uitset beweging}}{\text{inset beweging}}$

1.

**BANDAANDRYWINGS****MEGANIESE TEGNOLOGIE: GRAAD 12-FORMULEBLADE**

$$1.1 \quad \text{Bandspoed} = \frac{60}{\pi D N}$$

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

$$1.3 \quad \text{Bandmassa} = \text{Area} \times \text{Lengte} \times \text{digtheid} \quad (A = \text{dikte} \times \text{wydte})$$

$$1.4 \quad \text{Spoedverhouding} = \frac{\text{Dia. van dryfkartool}}{\text{Dia. van gedrewe kartool}}$$

$$1.5 \quad \text{Uitset spoed} = \frac{\text{gedrewe kartool}}{\text{dryfkartool}} \times \frac{\text{gedrewe kartool}}{\text{dryfkartool}} \times \text{insetspoed}$$

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

$$1.7 \quad \text{Gekruisde bandsnugte} = \frac{2}{\pi(D+d)} + \frac{4c}{(D+d)^2} + 2c$$

$$1.10 \quad \text{Drywing (P)} = \frac{60}{(\text{T}_1 - \text{T}_2) \pi DN} \quad \text{waar } \text{T}_1 = \text{krag aan die stywe kant}$$

$$1.11 \quad \text{Wydte} = \frac{\text{Toelatbare trekkrug}}{\text{T}_1}$$

**WRYWINGSKOPPELARES**

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

$$\begin{aligned} R &= \text{effektiewe radius} \\ n &= \text{aanval wrywingsoppervlakte} \\ W &= \text{totale druk} \\ H &= \text{wrywingskoeffisient} \end{aligned}$$

$$2.1 \quad \text{Wringkrag (T)} = \frac{1}{2} W n R$$

Skuer af en handig met antwoordeboek in.

VRAAG				ANTWOORDBLAAD			
1 (MEERVOUDIGEKEUSE-VRAE)							
1.1	A	B	C	D			
1.2	A	B	C	D			
1.3	A	B	C	D			
1.4	A	B	C	D			
1.5	A	B	C	D			
1.6	A	B	C	D			
1.7	A	B	C	D			
1.8	A	B	C	D			
1.9	A	B	C	D			
1.10	A	B	C	D			
1.11	A	B	C	D			
1.12	A	B	C	D			
1.13	A	B	C	D			
1.14	A	B	C	D			
1.15	A	B	C	D			
1.16	A	B	C	D			
1.17	A	B	C	D			
1.18	A	B	C	D			
1.19	A	B	C	D			
1.20	A	B	C	D			
TOTAL							

Voorbeeld: 1.21  B C D

Dui die korrekte antwoord met 'n kruisie (X) aan.

GRAAD 12: \_\_\_\_\_ NAM: \_\_\_\_\_

VRAAG 1 moet op die ANTWOORDBLAAD beantwoord word.

GRAAD 12

MEGANIESE TEGNOLOGIE: ANTWOORDBLAAD



**TOTAL: 200**

**[40]**

(5)

(3)

6.9 Beskryf die basiese werkingsprincip van 'n stoomturbine.  
ondersoek wat uitgevoer moet word voordat die welsporingsstoets uitgevoer  
lei tot ergie bandslystasie asook struktuur- of sporingsprobleme. Noem DRIE vooraf  
Die bande van 'n voertuig is ondrehewig aan slystasie. Verkeerde welsporing  
kan word.

(4)

6.7 Noem TWEE voordele van 'n stoom turbine en TWEE voordele van 'n gas  
turbine.

(2)

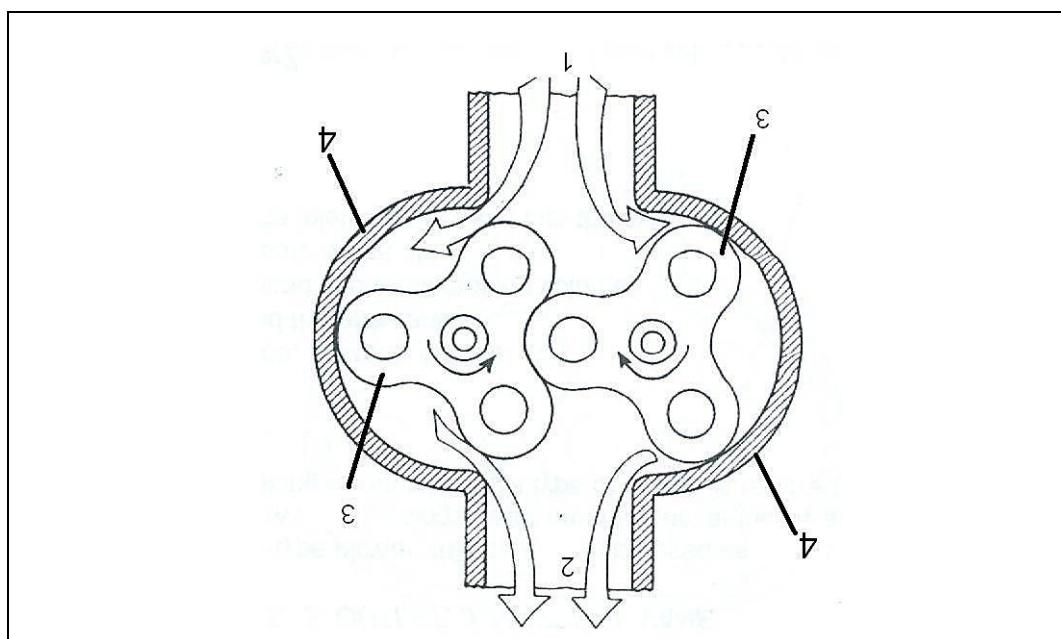
6.6.3 Noem TWEE nadelle van die gebruik van 'n superaanjaer.

(2)

6.6.2 Noem TWEE voordele van die gebruik van 'n superaanjaer.

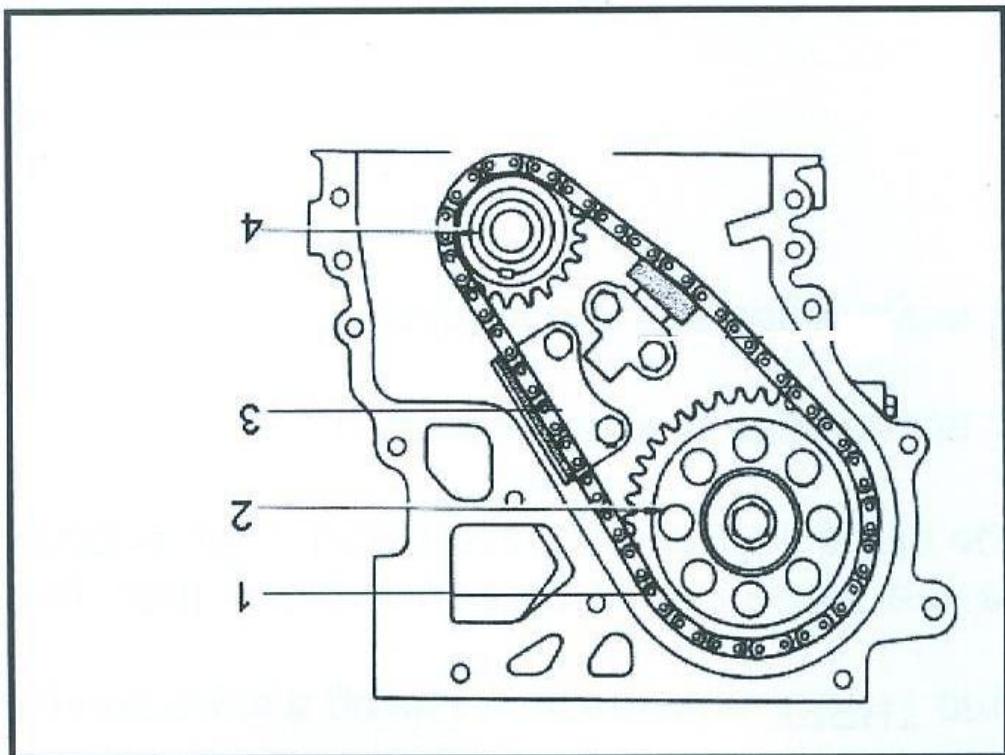
(4)

6.6.1 Benoem die onderselde genommer 1 tot 4.



6.6 Jy gaan deelneem aan 'n versnelwedren byeenkomste. Jou Datsun 1400 bakkie  
se werkverrigting kan drasties verbeter deur 'n superaanjaer te gebruik. Die  
figuur toon 'n type blaser wat jy kan gebruik.

(4)



- 6.5 'n Tydreeelaar-ketting speel 'n belangrike rol in 'n enjin. Gegee hieronder is 'n deursnee skeets van 'n enjin met 'n tydreeelaarketting. Benoem die onderdele in die skeets gemerk 1 – 4.

KOLOM A		KOLOM B
6.4.1 Vierslag petrol enjin	A EP 90	C SAE 20W50
6.4.2 Motor ratkas	B SAE 75W90	(1)
6.4.3 Bakke ewenaar	C SAE 20W50	(1)

- 6.4 Verbind die olieprodukte in KOLOM B met die beskrywing in KOLOM A deur die gekose letter langs die nommer in KOLOM A neer te skryf, byvoorbeeld 6.4.4 D.
- 6.5 Noem DRIE eienskappe van gries.
- 6.6 Goeie smeerolie het verskillende eienskappe. Viskoositeit is een van die eienskappe. Definieer die term viskoositeit.
- 6.7 Lang lewensduur vir rate is moontlik indien die olie gereeld vervang word. Jou skool se trekker-ewenaar se olie moet afgetaap en met nuwe olie gevul word. Beskyf stapsgewys hoe jy te werk sal gaan om die ewenaar se olie van die trekker te vervang.
- 6.8 Verbind die olietyp in KOLOM A met die olietyp in KOLOM B.

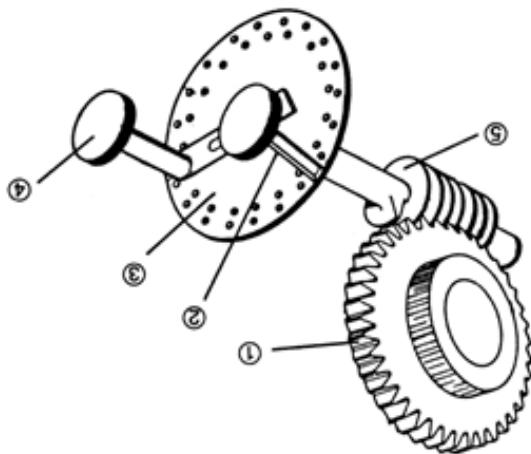
## VRAAG 6: TURBINES EN ONDERHOU

[50]

- 5.7 Devon, h swelislainspecteur, is besig om swelisgehalte toetsse uit te voer.
- 5.7.1 Noem TWEE oorsake van porreushheid in h swelisla's. (2)
- 5.7.2 Noem EEN stap wat gevolg moet word om porreushheid in h swelisla's te voorkom. (1)
- 5.7.3 Noem TWEE oorsake van gebreklike smelting van h swelisla's. (2)
- 5.7.4 Devon gebruik die kleurstofdeurdringtoets. Verduidelik hoe die prosedure op die swelisla's uitgevoer sal word. (7)
- 5.8 Bepaal deur berekening die toevaler in millimeter per minuut van h 120 mm diameter freesnijer met 40 tanden, wat teen h syspoed van 85 meter per minuut en h toevaler van 0,01 mm per tand werk. (6)

(5)

FIGUUR 5.6



(1)

5.4.3 Die draairigting van die indeksplaat

(5)

5.4.2 Die rate benodig

(3)

5.4.1 Die indeksering

(4)

5.3.2 'n hoek van  $11^{\circ}40'$

(3)

5.3.1 'n rat met 19 tandé

(4)

5.3 Bereken die indeksering in elk van die volgende gevalle:

(3)

5.2 Dien moet 'n lengte van 125 mm van 'n 50 mm diameter "POM C" staaf afsaag. Noem VIER veiligheidsmaatreëls wat van toepassing is wanneer daar moet 'n kragsaag gebruik word.

(4)

5.1 Skryf neer DRIE veiligheidsmaatreëls wat nagekom moet word wanneer 'n wringtoets gebruik word.

(4)

5.5 Maak TWEE netjiese skeete om die verskil tussen ofreeswerk en klimfreeswerk te wys. Dui die rigting van rotasie aan.

(5)

5.6 FIGUUR 5.6 toon die werkende onderdele van die verdeelkop. Benoem die onderdele genoemmer 1 – 5.

(5)

- 4.1 Suiwer metaale is oor die algemeen sag en betreklik swak. Sodraa ander metaale of nie-metale daarby gevoueg word, verbetaer hulle eienskappe.
- 4.1.1 Wanneer antimoon by die metal togerevoeg word, verhoog die allooi se ... . (Vul die ontbrekende word in.)
- 4.1.2 Allooi word onder ander geskep om 'n harder, taaiier metal te vorm. Noem enigge VIER ander redes vir die skep van allooi.
- 4.2 Noem DRIE redes waarom aluminium gebruik word vir die maak van kombuisgeredskap sowel as seevaartuie.
- 4.3 Noem DRIE voordele en DRIE nadele van termoplastiek teenoor termoverhardende plastiek.
- 4.4 Soldersel is 'n allooi van ... . (Vul die ontbrekende word in.)
- 4.5 Koolstofvesel is 'n baie gewilde materiaal in sporttoerusting. Noem TWE redes waarom renfietersrame daarvan vervaardig word.
- 4.6 Definieer 'n nie-ferro allooi en gee EN voorbeel daarvan.

[20]

(2)

(2)

(2)

(6)

(3)

(4)

(1)

(1)

(1)

(1)

(1)

(1)

(1)

#### VRAAG 4: MATERIALE

[20]

(4)

3.7 Gee VIER moonlike benvindings wanneer 'n silinderkassie-toets op 'n enjin uitgevoer word.

(2)

3.6 Noem die TWEE gasse wat gebruik word vir MAGS/MIGS swelising.

(2)

3.5 Wat vereenwoordig die afkorting MAGS/MIGS in terme van swelisstofrestsing?

(3)

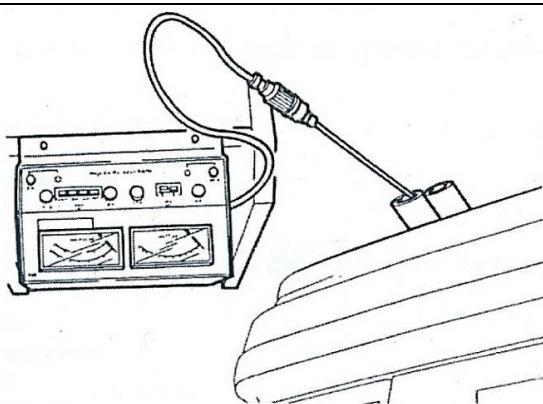
3.4 Die trektoetsers is ontwerp om drie funksies te bepaal wanneer 'n stuk materiaal getoets word. Noem die DRIE funksies.

(4)

3.3 Na die gas analisator toets afgewandel is, duï die masjiene 'n hoe hidrokooldstoflesing aan. Gee VIER redes vir die hoe hidrokooldstoflesing.

**FIGUUR 3.2**

(1)

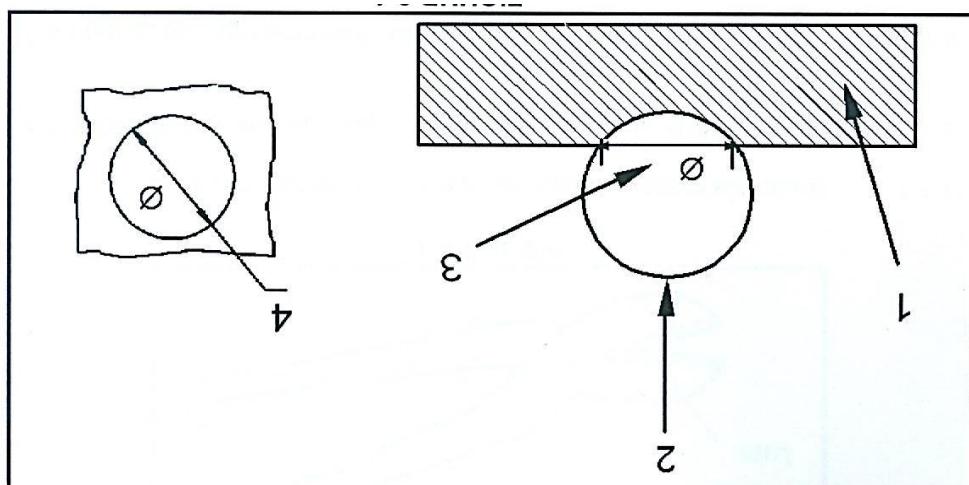


3.2

Identifiseer die diagnostiese toerusting aangewend in die figuur.

**FIGUUR 3.1**

(4)



op die figuur.

3.1 Michael gebruik die Brinell-hardheidstoets om die toetsstuk wat deur die instrukteur aan hom gegee is, te toets. Die figuur hieronder toon die toetsstuk gedurende die toets. Benoem die figuur volgens die nommers op die figuur.

### VRAG 3: GEREDSKAP EN TOERUSTING

[50]

(3)

2.7.2 Die drywing oorgedra teen 3 700 r/min in KW

(3)

2.7.1 Die maksimum wrykrag wat oorgedra kan word

volgende:

Die koppelaarplaat het wrywingsmateriaal aan beide kante met 'n Enkeleplaatwrywingskoppelaar het 'n effektiwe diameter van 0,28 m. Die koppelaarplaat is 4 KN. Bereken en noem die korrekte eenheid vir die wrywingskoeffisient van 0,36. Die totale toegepaste krag op die drukplaat is 4 KN.

(2)

2.6.3 Meganiiese effektiwiteit

(2)

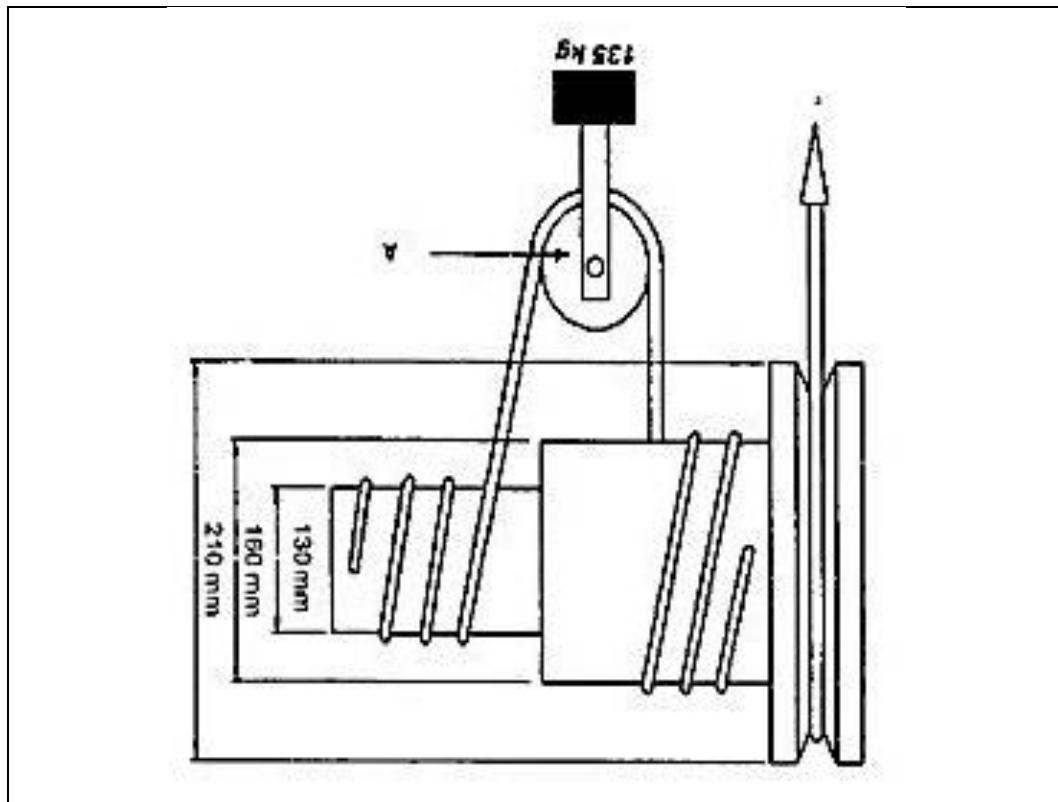
2.6.2 Die snelheidswerhouding

(2)

2.6.1 Mag toegepas

Bereken:

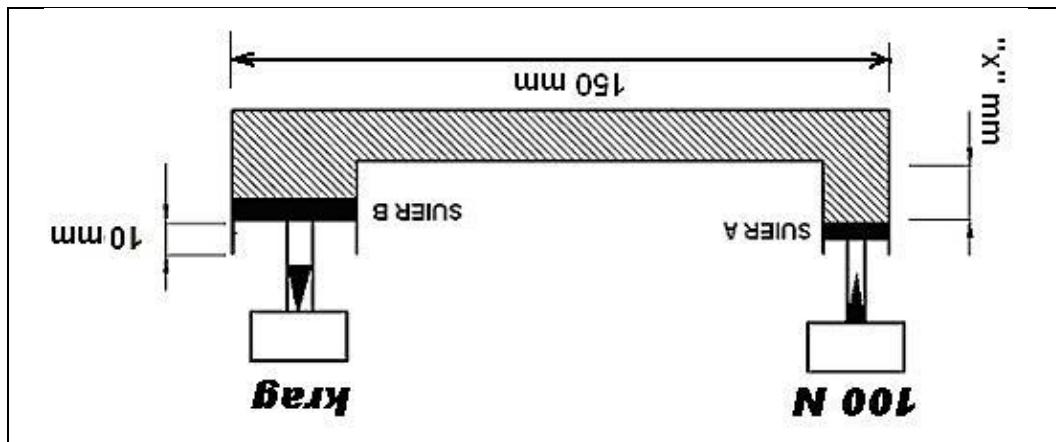
FIGUUR 2.6



2.6 'n Differensiaal wiel en as hysmasjien het 'n meganiiese hefvoordel van 4. 'n Werkstuk van 135 kg moet gelig word.

- 2.4.1 Berken die krag wat suier B sal uitlofen. (3)
- 2.4.2 Berken die afstand in millimeters wat suier A afwaarts beweeg het. (3)
- 2.4.3 As die afstand van 150 mm na 300 mm verleng word, watter invloed sal dit op die drukking in die stelsel hê? (1)
- 2.5 'n Driegang vierkantige skroefdraad met 'n stygging van 12 mm moet op 'n 50 mm diameter as gesny word. Die vryloophoek is  $3^\circ$ . Bereken die ingryp- en sleephoek van die skroefdraadsnybeteil. (8)

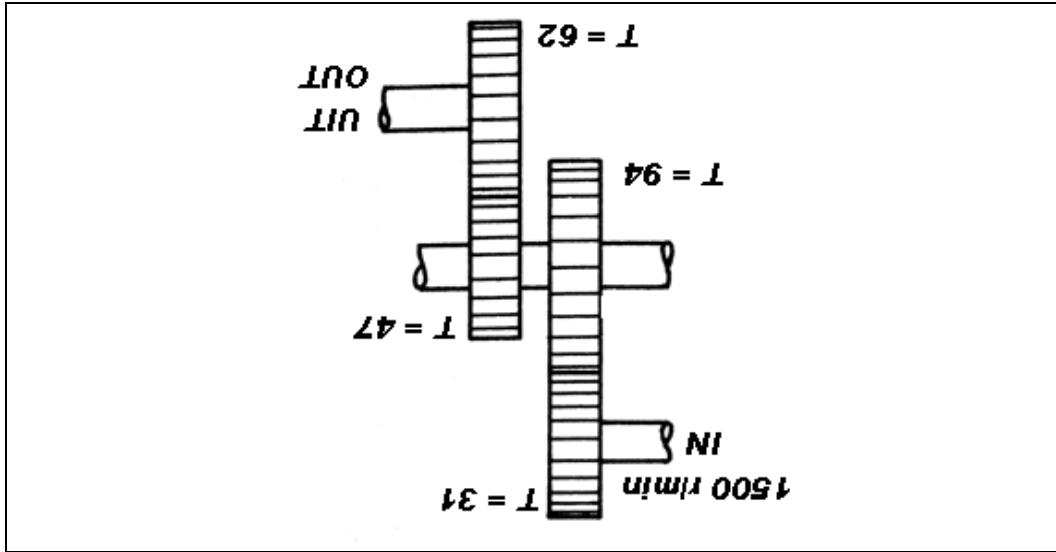
**FIGUUR 2.4**



- 2.4 'n Krag van 100 N word op suier A van 'n hidrouliese pers uitgeoeffen. Die diameter van suier A is 150 mm en suier B is 750 mm.

- 2.3.1 Die S.S.D. van die rat  
(4)
- 2.3.2 Die addendum  
(2)
- 2.3.3 Die dedendum  
(2)
- 2.3.4 Die volle diepte  
(2)
- 2.3.5 Die vryruimte  
(2)
- 2.3 H Heiliese rat moet 48 tandje hê met 'n normale module van 5 mm. Die helikshoek is 28°. Bereken:
- 2.2.1 Die rat verhouding  
(2)
- 2.2.2 Die uitst spoeed  
(2)
- 2.2.3 Die uitst wringkrag  
(3)
- 2.3 H Heiliese rat moet 48 tandje hê met 'n normale module van 5 mm. Die helikshoek is 28°. Bereken:

FIGUUR 2.2



- 2.2 H Meganiiese ingenieur moet 'n saamgestelde rat-aandrywing ontwerp vir 'n geriedskapsakk masjién, soos in die figuur hieronder. Die inset as verplaas 5 kW teen 1 500 r/min. Bereken:
- 2.1.1 Die veiligheidsfaktor  
(2)
- 2.1.2 Die spanning veroorsak in die stang  
(2)

2.1 H Staalslang, 20 mm diameter, is onderhewig aan 'n trekkrug van 17 kN. Die staalslang sal breek as die maksimum las van 85 kN oorskry word. Bereken:

## VRAAG 2: KRAGTE, STELSELS EN BEHEER

[20]

(1)

- A 8 m
- B 6 m
- C 4 m
- D 2 m

1.20 Die konsep sloerings en druk is alleenlik van toepassing op:

(1)

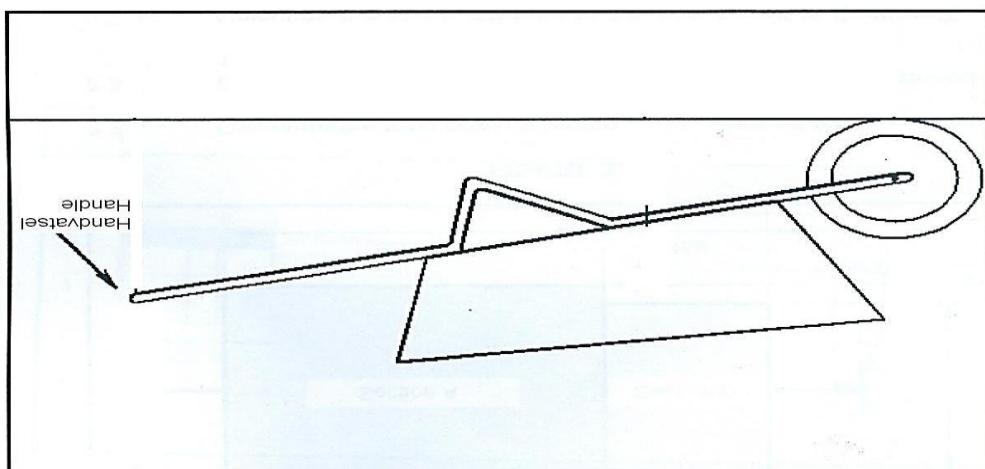
- A Drukking is een voorwerp regdeur die stelsel.
- B Volume is direk eweredig aan druk.
- C Hidrouliese verskaf 'n meganiese voordeel.
- D Hidrouliese sisteme moet 'n druk-ontlasteklep he.

1.19 Enige hidrouliese volleistof is nie saamdrukbaar en sal daarom in hidrouliese stelsel krag direk oorbring. Analiseer die stelling hidronder en dui aan watter stelling is onwaar vir 'n hidrouliese stelsel.

(1)

- A Eerste klas
- B Tweede klas
- C Derde klas
- D Vierde klas

FIGUUR 1.18



Die hefboom in die figuur is 'n ... hefboom.

1.18 Voltooi die sin deur die ontbrekende wordd in te vul.

(1)

- A 27 mm
- B 5 mm
- C 15 mm
- D 9 mm

Wat sal die stygging van die skroefdraad wees?

1.17 In Die begin Acme skroefdraad het 'n steek van 9 mm. Die draaibank wat gebruik word om die draad te snij het 'n leiskroef met 'n 5 mm steek.

(1)

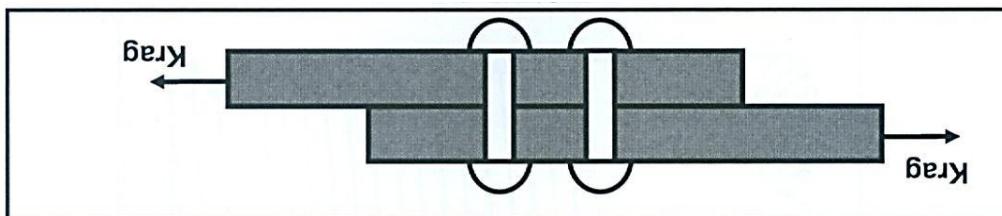
- A sysele af te koel.
- B werkstasie koel te hou.
- C masjiene af te koel.
- D werkstuk en gereedskapp koel te hou.

1.16 Sywloëistof word gedurende masjineringsprosesse gebruik om ...

(1)

- A Afskuifspanning
- B Trekspanning
- C Drukspanning
- D Stootspanning

FIGUUR 1.15



FIGUUR 1.15 geplaas word.

1.15 Analiseer onder watter type spanning die klinknaels soos aangegebon in

(1)

- A Om die grootte van die swelslas te toets
- B Om sweliswerker en swelslás aan sekere standaarde goed te keur
- C Om sweliswerker se varaidigheid te toets
- D Om die sweliswerker se varaidigheid te toets

1.14 Wat is die rede vir die visuele inspeksie van swelslásse?

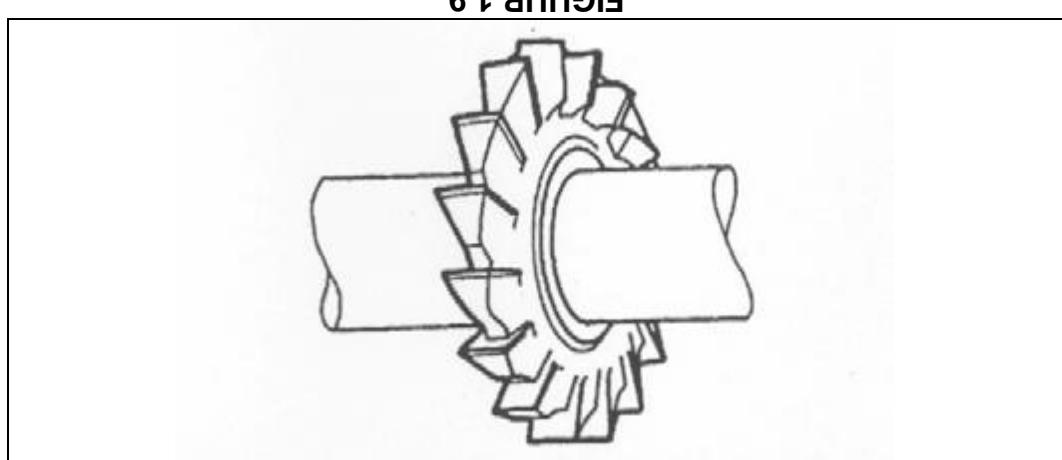
(1)

- A gelijk
- B wiessel
- C enkelefasie
- D driefase

MIG swelismasjiene is ...-stroomb-swelismasjiene?

1.13 Voltooi die sin deur die ontbrekende woord in te vul.

- 1.10 Wat dui die akroniem **SAE** in terme van smeerolie aan?
- (1)
- A Gelykhoekige freesnyer
  - B Sy- en vlaakfreesnyer
  - C Konveks freesnyer
  - D Gekerde heilisee snyer
- 1.11 Die doel van die oliepomp in 'n motorvoertuig is om die ...
- (1)
- A hitteverlies te verminder.
  - B olie te reinig van onsuiwerhede.
  - C olietemperatuur te reguleer.
  - D olie onder druk te sirkuleer.
- 1.12 Wattre van die volgende veiligheidsmatreëls behoort in gedagte gehou te voorKom, wat deur spattende vokke veroorsaak kan word?
- (1)
- A Sweiser behoort deur middel van handskoene geïsoleer te wees
  - B Die area moet afgeskeerm wees
  - C Verwyder brandbare materiaal uit swelaera
  - D Hou kabels en gereedskap georganiseerd



1.9 Identifiseer die type freesnyer wat in FIGUUR 1.9 hieronder getoon word.

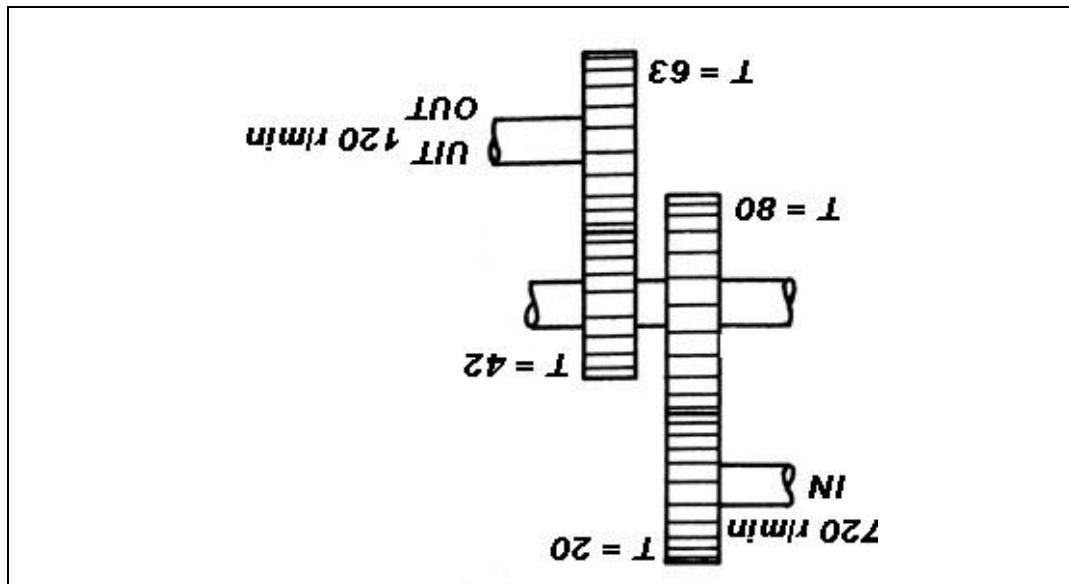
(1)

- A uitlaatgasse.
- B stoom.
- C meganiese aandrywing
- D alternator.

1.8 In Sentrifugale turbo-aanjager word aangedryf deur ...

(1)

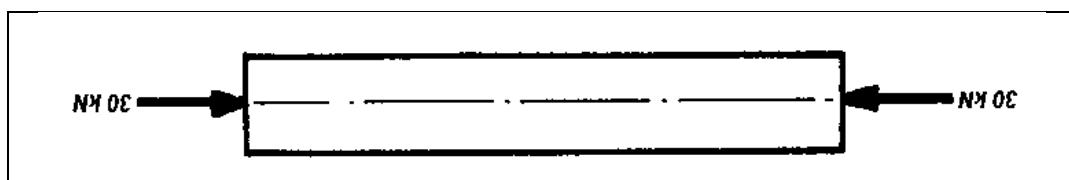
- A 1 : 6
- B 1 : 7
- C 6 : 1
- D 7 : 1



1.7 Bereken die spoevrehouding van die samgestelde rat-aandrywing in die onderskande figuur.

(1)

- A 169,77 MPa
- B 169,77 KPa
- C 159,15 MPa
- D 159,15 Pa



1.6 Bereken die drukspanning in 'n 15 mm-ronde geelkop staaf indien dit aan 'n drukas van 30 kN onderwerp word.

(1)

- A 1 : 40.  
B 20 : 1.  
C 1 : 80.  
D 40 : 1.

1.5 Die verdeelkop se verhouding is ...

(1)

- A Verharder staal  
B Karbied  
C Diamant  
D Kobalt

1.4 Die Vickers-harheidstoets indrukker word van watter materiaal gemaak?

(1)

- A persentasie verlewing  
B harheid  
C vringkrag  
D interne spanning

1.3 Die funksie van die trektoester is om die ... van metal te bepaal.

(1)

- A Polistireen  
B Polivinilechloried  
C Polipropyleen  
D Polietilreen teretalaat

1.2 Identifiseer die polymeer wat gebruik sal word om waterbotteloppe te vervardiig.

(1)

- A Koper en Sink  
B Tin en Koper  
C Tin en Lood  
D Sink en Lood

1.1 Brons is 'n alloui van watter nie-sterhouende metaal?

VOORBEELD: 1.21  A  B  C  D

Verskeie opsiges word as moonlike antwoorde vir die volgende vrae gegee. Kies die antwoord en maak 'n kruisje (X) in die blokkie (A-D) langs die vragnommer (1-120) op die aan gehengte ANTWOORDBLAD.

## VRAAG 1: MEERVOUDIGEKUSE-VRAE

Vraag	Assessering-s-	Inhoud wat gedek word	Punte	Tyd	Total	180 minute
6.	7 en 9	Turbines en onderhoud	40	36 minute		
5.	1, 4 en 5	Veiligheid, Terminologie en Hesgingmetodes	50	45 minute		
4.	3	Materiale	20	18 minute		
3.	2	Gereddeskap en toerusting	20	18 minute		
2.	6 en 8	Kragte, Stelsels en Beheer	50	45 minute		
1.	1 - 9	Meervoudigkeuse-vrae	20	18 minute		

1. Skryf jou naam en van in die betrokke spasies wat op jou ANTWOORDBLAD verskaf word.
2. Beanwoord AL die vrae.
3. Bestudeer ALLE vrae deeglik.
4. Vraagnommers en antwoord moet ooreenstem met die wat in die vraestel voorkom.
5. Skryf duidelik en leesbaar.
6. Toon alle berekening en eenhede.
7. Kandidate mag nieprogrammeerbare wetsenskaplike sakrekenaars, asook teken-en wiskundige instrumente gebruik.
8. Die waarde van die gravitasie versnelingskonstante moet as  $10 \text{ m/s}^2$  genoem word.
9. Gebruik die onderstannde kriteria om jou te help met die beplanning van jou antwoordstel.

## INSTRUKSIES EN INLIGTING

Hierdie vraestel bestaan uit 22 bladsye insluitend 'n antwoordblad  
en 4-bladsy formulieblad.



TYD: 3 uur

PUNTE: 200

## MEGANIESE TEGNOLOGIE

SEPTEMBER 2013

GRAAD 12

SENIOR SERTIFIKAAT  
NASIONALE

EDUCATION  
PROVINCE OF THE  
EASTERN CAPE

