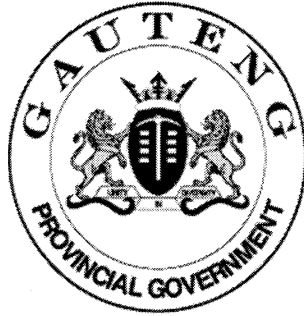


**SENIOR CERTIFICATE EXAMINATION  
SENIORSERTIFIKAAT-EKSAMEN**



**OCTOBER / NOVEMBER  
OKTOBER / NOVEMBER**

**2004**

**FITTING AND  
TURNING**

***PAS- EN  
DRAAIWERK***

**SG**

**705-2/0**

**11 pages  
11 bladsye**

FITTING & TURNING SG



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GAUTENGSE DEPARTEMENT VAN ONDERWYS  
SENIORSERTIFIKAAT-EKSAMEN

PAS- EN DRAAIWERK SG

TYD: 3 uur

PUNTE: 200

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**BENODIGHEDE:**

'n Sakrekenaar en tekeninstrumente

**INSTRUKSIES:**

- Beantwoord ALLE vrae volledig.
  - Tensy anders vermeld, word alle afmetings in millimeter aangegee.
  - Vir ALLE toepaslike vrae is die verdeelkopverhouding 40:1 en die freemasjienleiskroefsteek 6 mm.
  - 'n Inligtingsblad word saam met hierdie vraestel verskaf.
  - Gebruik SLEGS die formules soos op die inligtingsblad aangedui. Afgeleides van hierdie formules kan egter ook gebruik word.
- 

**VRAAG 1**

Beantwoord die volgende vrae op die **antwoordblad** aan die **binnekant van die omslag** van die **antwoordboek**. Dui die korrekte antwoord(e) aan deur 'n kruis (X) oor die toepaslike letter(s) op die antwoordblad te trek. Die puntetoekenning aan die regterkant is 'n aanduiding van die aantal moontlike korrekte antwoorde vir elke vraag. Daar is soms meer as een korrekte antwoord.

1.1 'n Rattandnonius word gewoonlik gebruik vir meting van die \_\_\_\_\_.

- A. koordaddendum
- B. koordtanddikte
- C. sirkelsteek
- D. dedendum

(2)

1.2 Die aantal snyers in 'n stel evolente freessnyers is \_\_\_\_\_.

- A. 12
- B. 9
- C. 8
- D. 16

(1)

GAUTENG DEPARTMENT OF EDUCATION  
SENIOR CERTIFICATE EXAMINATION

FITTING AND TURNING SG

TIME: 3 hours

MARKS: 200

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**REQUIREMENTS:**

A pocket calculator and drawing instruments

**INSTRUCTIONS:**

- Answer ALL the questions in full.
  - Unless otherwise indicated, all dimensions are in millimetres.
  - For ALL applicable questions, the dividing head ratio is 40:1 and the milling machine lead screw pitch is 6 mm.
  - An information sheet is supplied with this question paper.
  - Use ONLY the formulae as indicated on the information sheet. Derivatives of these formulae may, however, also be used.
- 
- 

**QUESTION 1**

Answer the following questions on the **answer sheet** on the **inside cover** of the **answer book**. For each question, indicate the correct answer(s) by marking a cross (X) over the appropriate letter(s) on the answer sheet. The mark allocation on the right-hand side is an indication of the possible number of correct answers for each question. There may be more than one correct answer.

1.1 A gear tooth vernier is usually used to measure the \_\_\_\_\_.

- A. chordal addendum
- B. chordal thickness
- C. circular pitch
- D. dedendum (2)

1.2 The number of cutters in a set of involute milling cutters is \_\_\_\_\_.

- A. 12
- B. 9
- C. 8
- D. 16 (1)

- 1.3 Groot heliese freessnyers word soms gekerf omdat dit \_\_\_\_\_.
- A. lang aaneenlopende snysels voorkom
  - B. druk op die draspil verminder
  - C. trillings verminder
  - D. die snyer se lewensduur verleng (2)
- 1.4 Die doel van ondersnyding aan die begin van 'n skroefdraad is om die \_\_\_\_\_.
- A. draad maklik te kan sny
  - B. worteldiameter van die draad aan te dui
  - C. vibrasies gedurende die snyproses te vermy
  - D. diepte van die skroefdraad aan te dui (2)
- 1.5 Ongelukke word veroorsaak deur persoonlike of werksfaktore. Kies die persoonlike faktore uit die onderstaande lys.
- A. Foutiewe elektriese bedrading
  - B. Verkeerde houdings
  - C. Baie min kennis
  - D. Masjiene in swak toestand (2)
- 1.6 Die werkdiepte van 'n rat verwys na die \_\_\_\_\_.
- A. middel van die rat
  - B. addendum plus die speling
  - C. dedendum plus die speling
  - D. diepte waarop die tande inkam (1)
- 1.7 Punt-van-aksieskerms word aangebring op \_\_\_\_\_.
- A. sirkelsae
  - B. roterende as-ente
  - C. guillotines
  - D. rataandrywings (2)
- 1.8 Heliese ratte dra meer krag oor as reguittandratte. Die rede hiervoor is dat \_\_\_\_\_.
- A. die helikshoek op heliese ratte groter is
  - B. heliese ratte uit groter diameter asse gesny kan word
  - C. kragoorbrenning altyd oor twee tande versprei word
  - D. die aandrywing stil is (1)
- 1.9 Volgens die Fabriekswet het die werkers ook 'n verantwoordelikheid ten opsigte van veiligheid in 'n werkswinkel. Selekteer die belangrikstes uit die onderstaande lys.
- A. Gebruik veilige werksmetodes.
  - B. Gehoorsaam en voer alle reëls, regulasies en opdragte uit.
  - C. Wees altyd vriendelik en hulpvaardig teenoor andere.
  - D. Groet eers jou meerderes voor jy begin werk. (2)

**[15]**

- 1.3 Large helical milling cutters are sometimes nicked because it \_\_\_\_\_.  
A. prevents long continuous shavings  
B. reduces pressure on the arbor  
C. reduces chatter  
D. lengthens cutter life (2)
- 1.4 The purpose of undercutting at the beginning of a thread is because it \_\_\_\_\_.  
A. facilitates easy cutting of the thread  
B. indicates the root diameter of the thread  
C. avoids vibration during the cutting process  
D. indicates the depth of the screw thread (2)
- 1.5 Accidents are caused by personal or work-related factors. Choose the personal factors from the list below.  
A. Faulty electrical wiring  
B. Wrong attitudes  
C. Very little knowledge  
D. Machines in poor condition (2)
- 1.6 The working depth of a gear refers to the \_\_\_\_\_.  
A. centre of the gear  
B. addendum plus clearance  
C. dedendum plus clearance  
D. depth at which the gears mesh (1)
- 1.7 Point of action guards are fitted to \_\_\_\_\_.  
A. circular saws  
B. rotating shaft ends  
C. guillotines  
D. chain drivers (2)
- 1.8 Helical gears transmit more power than spur gears. The reason for this is that \_\_\_\_\_.  
A. the helix angle on helical gears is larger  
B. helical gears can be cut from larger diameter shafts  
C. power transfer is always distributed over two gears  
D. the drive is silent (1)
- 1.9 According to the Factories Act, the workers also have a responsibility towards safety in a workshop. Select the most important ones from the list below.  
A. Practise safe working methods.  
B. Obey and carry out all rules, regulations and orders.  
C. Always be polite and helpful towards others.  
D. First greet your superiors before starting to work. (2)

- 1.10 Lees die volgende stellings versigtig deur en dui aan of dit waar of vals is deur die woorde WAAR of VALS langs die toepaslike vraagnommer in jou antwoordboek te skryf.
- 1.10.1 Wrywing is direk eweredig aan die las wat loodreg op die oppervlak toegepas word. (1)
- 1.10.2 Die ingeslote hoek van 'n ACME skroefdraad is  $29,5^\circ$ . (1)
- 1.10.3 Statiese balansering beteken dat die werk gebalanseer word terwyl dit stil staan. (1)
- 1.10.4 Wanneer tandstange gesny word, word die indeksplaat in posisie gesluit. (1)
- 1.10.5 Groeprees is wanneer die snyers akkuraat gespaseer word deur krae. (1)
- 1.10.6 Wanneer druk op 'n vloeistof uitgeoefen word, sal die vloeistof energie opgaan soos 'n soliede stof. (1)
- 1.10.7 'n Tydelike skerm kan gebruik word om masjiene te beveilig. (1)
- 1.10.8 Die bo en onder vlakke van 'n goed-ontwerpte sinusstaaf is parallel. (1)
- 1.10.9 Die loskop van 'n senterdraaibank kan nie vir tapse draaiwerk gebruik word nie. (1)
- 1.10.10 Die styging en buitenediameter van 'n skroefdraad bepaal die grootte van die helikshoek van die draad. (1)
- 1x10=(10)  
**[25]**

## VRAAG 2

- 2.1 Meld VYF doelwitte van instandhouding. (5)
- 2.2 Beskryf kortliks die verskil tussen absolute en inkrementele programmering. (3)
- 2.3 'n Betonpilaar met sye 300 mm x 250 mm word gebruik om 'n tenk met 'n massa van 2500 kg te ondersteun. Bereken die
- 2.3.1 deursnee-area van die pilaar in  $m^2$ .
- 2.3.2 spanning wat in die pilaar ontwikkel word in kPa. (7)

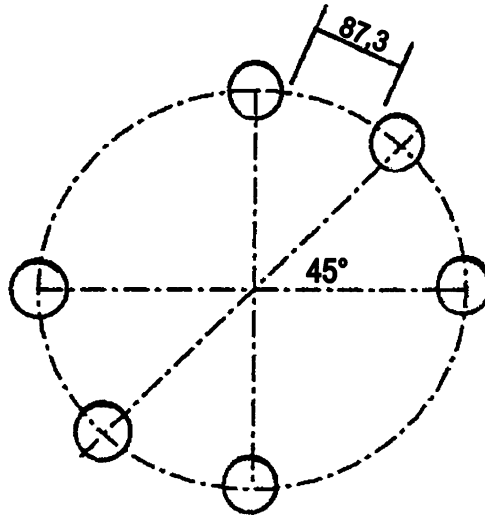
- 1.10 Read the following statements carefully and state whether they are true or false by writing the words TRUE or FALSE next to the relevant question number in your answer book.
- 1.10.1 Friction is directly proportional to the load applied perpendicular to the surface. (1)
- 1.10.2 The included angle of the ACME screw thread is  $29,5^\circ$ . (1)
- 1.10.3 Static balancing means that the work is balanced while it is stationary. (1)
- 1.10.4 When gear racks are cut, the index plate must be locked in position. (1)
- 1.10.5 Gang milling is when the cutters are spaced accurately by means of collars. (1)
- 1.10.6 When pressure is applied to a liquid, the liquid will store energy like a solid substance. (1)
- 1.10.7 A temporary guard can be used to safeguard machinery. (1)
- 1.10.8 The top and bottom planes of a well-designed sine bar are parallel. (1)
- 1.10.9 The tailstock of a centre lathe cannot be used for taper turning. (1)
- 1.10.10 The lead and outside diameter of a screw thread determines the size of the helix angle of the thread. (1)

1x10=(10)  
[25]

### QUESTION 2

- 2.1 Mention FIVE aims of maintenance. (5)
- 2.2 Briefly describe the difference between absolute and incremental programming. (3)
- 2.3 A concrete pillar with sides 300 mm x 250 mm is used to support a tank with a mass of 2 500 kg. Calculate the
- 2.3.1 cross-sectional area of the pillar in  $m^2$ .
- 2.3.2 stress developed in the pillar in kPa. (7)

- 2.4 Die onderstaande skets toon die opstelling om ses gate in 'n staalplaat te boor. Vyftien millimeter diameter gereedskapmakersknoppies word gebruik om die gate akkuraat te spasieer. Bereken die SSD van die gate. (8)



- 2.5 'n Reguittandrat het 60 tande en 'n module van 5 mm. Bereken die volgende gewens van die rat.

- 2.5.1 Steeksirkeldiameter
- 2.5.2 Buitediameter
- 2.5.3 Addendum
- 2.5.4 Dedendum
- 2.5.5 Werkdiepte
- 2.5.6 Volle diepte

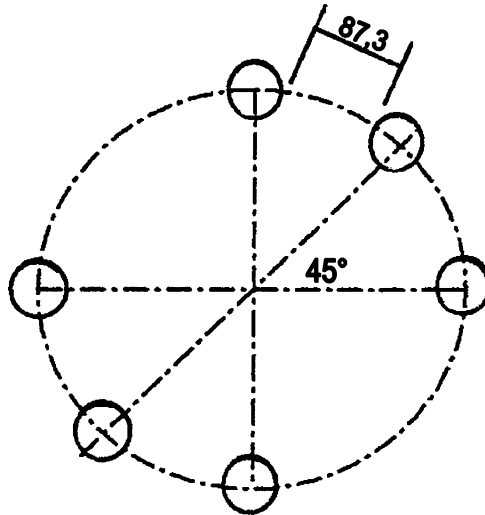
(12)  
[35]

### VRAAG 3

- 3.1 Verduidelik met die hulp van eenvoudige sketse die verskil tussen **koppel-** en **groeprees** en gee die doel van elk. (8)
- 3.2 Noem VIER voordele van klimreeswerk. (4)
- 3.3 Wat is die doel van die sekondêre vryloophoek op 'n freessnyer? (2)
- 3.4 Noem VIER besonderhede wat aan die kant van 'n evolente ratrees aangetoon moet word. (4)
- 3.5 Maak 'n eenvoudige skets om aan te toon hoe 'n sy- en vlakrees op 'n ronde werkstuk op 'n freemasjien gesentreer moet word deur 'n winkelhaak en 'n liniaal te gebruik. (6)



- 2.4 The sketch below shows the set-up for drilling six holes in a steel plate. Fifteen millimetre diameter toolmakers' buttons are used to space the holes accurately. Calculate the PCD of the holes. (8)



- 2.5 A straight tooth gear has 60 teeth and a module of 5 mm. Calculate the following particulars of the gear.

- 2.5.1 Pitch circle diameter
- 2.5.2 Outside diameter
- 2.5.3 Addendum
- 2.5.4 Dedendum
- 2.5.5 Working depth
- 2.5.6 Full depth

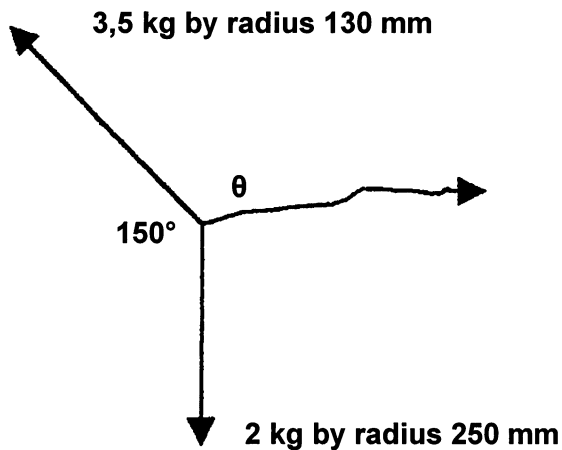
(12)  
[35]

### QUESTION 3

- 3.1 Explain by means of simple sketches the difference between **straddle** and **gang milling** and give the purpose of each. (8)
- 3.2 State FOUR advantages of down-cut milling. (4)
- 3.3 What is the purpose of the secondary clearance angle on a milling cutter? (2)
- 3.4 Name FOUR particulars that must be shown on the side of an involute gear cutter. (4)
- 3.5 Make a simple sketch to illustrate how a side and face milling cutter on a round workpiece should be centred on a milling machine using a square and a ruler. (6)

- 3.6 Die volgende is 'n diagrammatiese skets van 'n ongebalanseerde hefboom. Bepaal grafies die massa van 'n balansstuk wat op 'n radius van 200 mm vanaf die huls van die hefboom geplaas moet word om die hefboom te balanseer. Bepaal ook die hoek  $\theta$ .  
Skaal: 1 mm = 5 kg mm

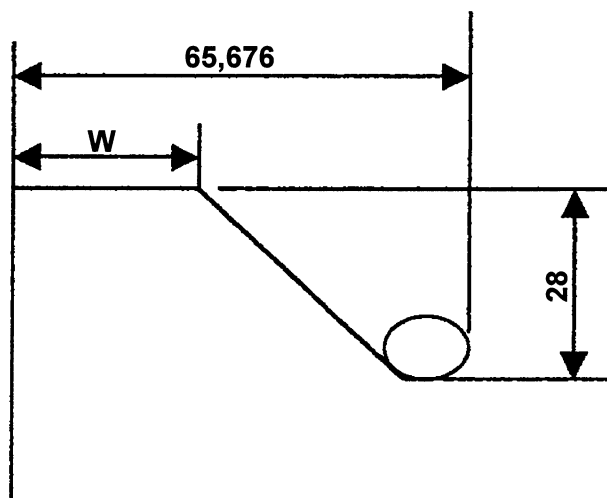
(11)



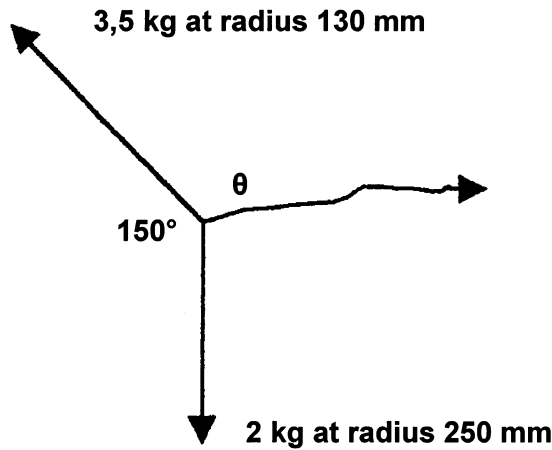
[35]

## VRAAG 4

- 4.1 Maak 'n netjiese skets van die rangskikking van die verdeelkopratte wanneer differensiaalindeksering gedoen moet word. (6)
- 4.2 Bereken die indeksring wat benodig word om 'n ronde werkstuk in 150 indelings te verdeel. (3)
- 4.3 'n Tandstang moet vervaardig word om met 'n kleinrat in te kam. Die kleinrat het 12 tande en 'n buitendiameter van 70 mm. Bereken die minimum indeksring benodig as die dryfrat vier keer soveel tande as die gedrewe rat het. (9)
- 4.4 Die masjienglybaan hieronder moet vir akkuraatheid getoets word deur middel van 'n 15 mm diameter presiesroller. Die ingeslote hoek van die glybaan is  $150^\circ$ . Bereken die afstand  $W$ . (11)



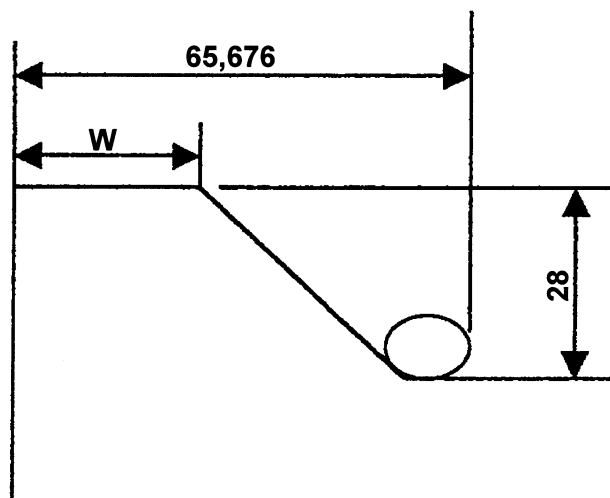
- 3.6 The following is a diagrammatic sketch of an unbalanced lever. Determine graphically the mass of a balance piece that must be placed at a radius of 200 mm from the hub of the lever in order to balance the lever. Also determine angle  $\theta$ .  
Scale: 1 mm = 5 kg mm (11)



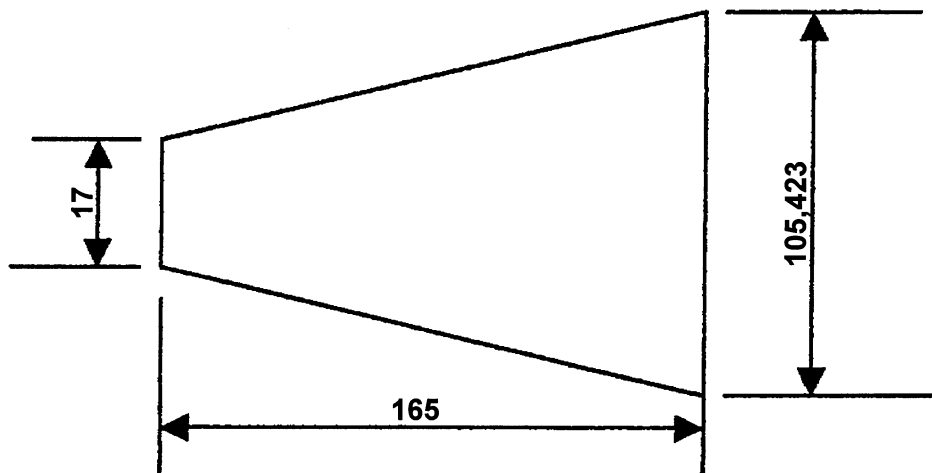
[35]

QUESTION 4

- 4.1 Make a neat sketch of the dividing head gear arrangement when differential indexing is performed. (6)
- 4.2 Calculate the indexing required to divide a circular workpiece into 150 divisions. (3)
- 4.3 A gear rack must be made to mesh with a pinion. The pinion has 12 teeth and an outside diameter of 70 mm. Calculate the minimum indexing required if the drive gear has four times the number of teeth as the driven gear. (9)
- 4.4 The machine slide below must be tested for accuracy by means of a 15 mm diameter precision roller. The included angle of the slide is  $150^\circ$ . Calculate the distance  $W$ . (11)



- 4.5 Die tapse propmaat hieronder moet vir akkuraatheid getoets word. Bereken die ingeslote hoek van die propmaat. (6)



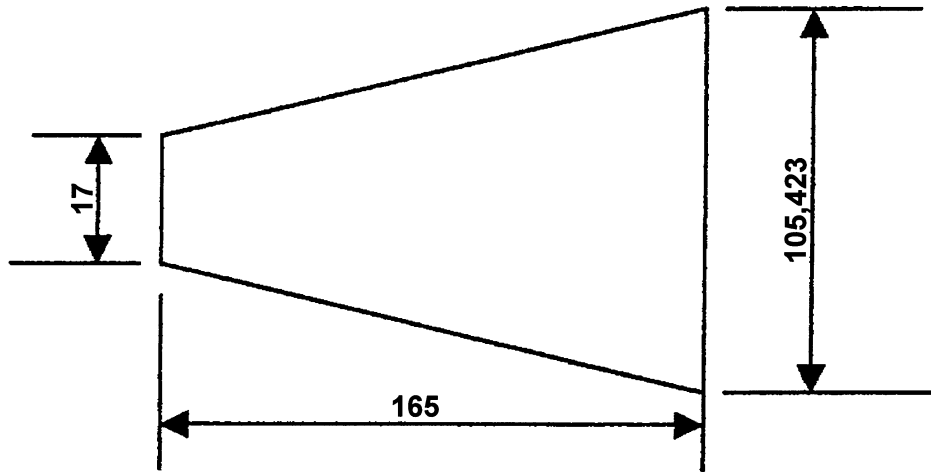
[35]

### VRAAG 5

- 5.1 5.1.1 Maak 'n netjiese skets om die **prosesuitleg** van masjiene te illustreer. (4)
- 5.1.2 Verduidelik wat jy onder hierdie tipe uitleg verstaan. (2)
- 5.2 'n Tweegang, buite vierkantige skroefdraad met 'n steek van 12 mm, moet op 'n 80 mm diameter as op 'n senterdraaibank gesny word. Die vryloophoek van die snybeitel is  $4^\circ$ .
- 5.2.1 Maak 'n netjiese skets van die skroefdraad, **met afmetings**, en dui die steek, die styging, die diepte en die dikte van die skroefdraad op jou skets aan. (6)
- 5.2.2 Verduidelik volledig hoe hierdie proses uitgevoer moet word deur die "oorstelling van die saamgestelde slee"-metode te gebruik. (10)
- 5.2.3 Bereken die
- styging van die skroefdraad.
  - helikshoek van die skroefdraad.
  - voorsnyhoek van die snybeitel.
  - nasleefhoek van die snybeitel. (9)
- 5.3 Maak 'n netjiese skets om aan te toon hoe statiese balansering met twee gelyke massastukke gedoen moet word. (4)

[35]

- 4.5 The tapered plug gauge below must be tested for accuracy. Calculate the included angle of the gauge. (6)



[35]

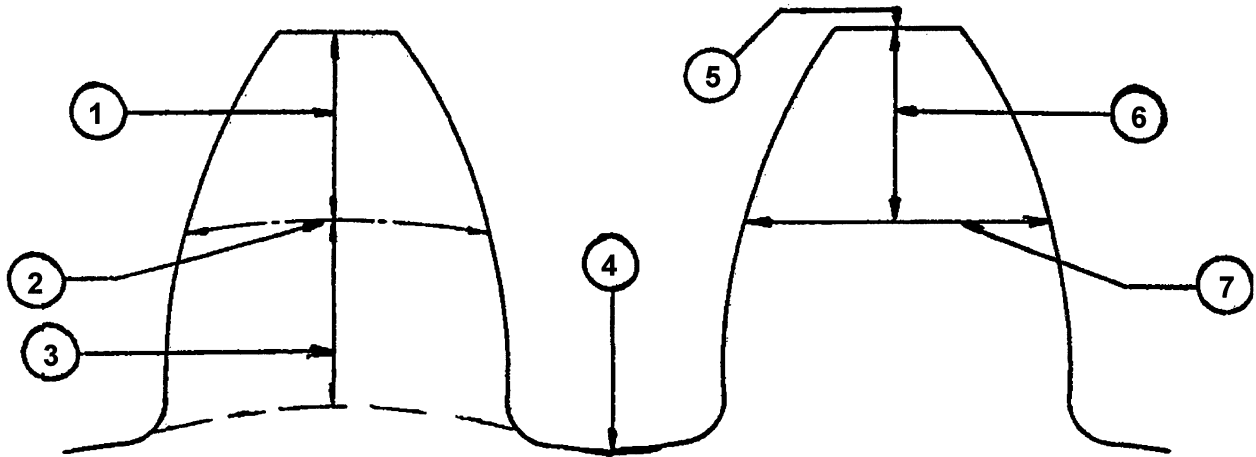
## QUESTION 5

- 5.1 5.1.1 Make a neat sketch to illustrate the **process layout** of machines. (4)
- 5.1.2 Briefly explain what you understand by this type of layout. (2)
- 5.2 A two-start external square thread with a pitch of 12 mm must be cut on an 80 mm diameter shaft on a centre lathe. The clearance angle of the cutting tool is  $4^\circ$ .
- 5.2.1 Make a neat sketch of the screw thread, **with dimensions**, and indicate the pitch, the lead, the depth and the thickness of the thread on your sketch. (6)
- 5.2.2 Explain in detail how this process should be carried out using the “set-over of the compound slide” method. (10)
- 5.2.3 Calculate the
- lead of the screw thread.
  - helix angle of the screw thread.
  - leading angle of the cutting tool.
  - trailing angle of the cutting tool. (9)
- 5.3 Make a simple sketch to indicate how static balancing is done with two equal mass pieces. (4)

[35]

## VRAAG 6

- 6.1 Maak 'n netjiese deursnee skets van 'n gereedskapmakersknoppie in posisie op 'n werkstuk. Die skets moet duidelik aantoon hoe die knoppie op die werkstuk vasgeheg is. (3)
- 6.2 Die onderstaande skets toon twee tande van 'n reguittandrat. Benoem die skets (1 – 7). (7)



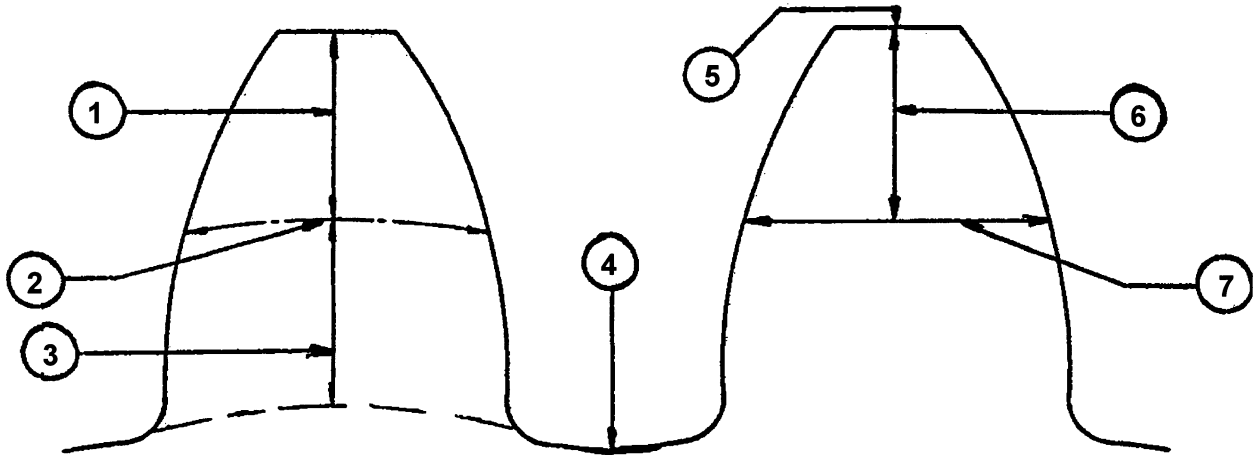
- 6.3 Maak 'n netjiese diagrammatiese skets van 'n heliese rat wat die helikshoek, die normale module en die ware module van die rat aandui. (3)
- 6.4 'n Reguittandrat word op 'n freesmasjien gesny. As die korrekte snyer nie vir die werk gebruik word nie, sal die vorm van die rattande beïnvloed word. Meld DRIE ANDER faktore wat ook die vorm van die tande kan beïnvloed. (6)
- 6.5 6.5.1 Bereken die oorstelling van die tandstut wanneer 'n 150 mm diameter sy- en vlakfrees geslyp moet word deur van 'n 200 mm diameter skyfslypwiël gebruik te maak. Die vryloophoek is  $7^\circ$ . (3)
- 6.5.2 Maak 'n netjiese skets van die opstelling om die posisie van die tandstut en die slypwiël ten opsigte van die snyer aan te toon. (5)
- 6.6 'n Krag van 600 N word op die 50 mm diameter plunjer van hidrouliese pers uitgeoefen. Die las wat deur die pers opgelig word, is 45 kN. Bereken die diameter van die ram. (8)

[35]

TOTAAL: 200

**QUESTION 6**

- 6.1 Make a neat cross-sectional sketch of a toolmakers' button in position on a workpiece. The sketch must clearly indicate how the button is attached to the workpiece. (3)
- 6.2 The sketch below shows two teeth of a spur gear. Label the sketch (1 – 7). (7)



- 6.3 Make a neat diagrammatic sketch of a helical gear showing the helix angle, the normal module and the real module of the gear. (3)
- 6.4 A spur gear is being cut on a milling machine. If the correct cutter is not used for the job, the shape of the gear teeth will be influenced. Mention THREE OTHER factors that may also influence the shape of the gear teeth. (6)
- 6.5 6.5.1 Calculate the offset of the tooth rest when a 150 mm diameter side and face milling cutter must be sharpened using a 200 mm diameter disk grinding wheel. The clearance angle is 7°. (3)
- 6.5.2 Make a neat sketch of this set-up to show the position of the tooth rest and the grinding wheel in relation to the cutter. (5)
- 6.6 A force of 600 N is exerted on a 50 mm diameter plunger of a hydraulic jack. The load lifted by the jack is 45 kN. Calculate the diameter of the ram. (8)

**[35]**

**TOTAL: 200**

## INLIGTINGSBLAD

1. Tandratte vir freesmasjien

Standaard- en spesiale tandratte.

24 (twee hiervan); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 en 100 tande.

2. Indeksplaat vir freesmasjien

24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 52; 54; 57; 58; 59; 62 en 66 gate.

3. Formules

$$3.1 \text{ Spanning} = \frac{F}{A}$$

$$3.2 \text{ Dwarsdeursnee-oppervlak van soliede silinder} = \frac{\pi D^2}{4}$$

$$3.3 \text{ Dwarsdeursnee-oppervlak van hol silinder} = \frac{\pi(D^2 - d^2)}{4}$$

$$3.4 \text{ Vloeistofdruk in 'n hidrouliese pers: } \frac{F1}{A1} = \frac{F2}{A2}$$

Volume van vloeistof deur plunjer verplaas = volume deur suier verplaas  
volume = area x L

## 3.5 Reguittandrat:

$$3.5.1 \text{ SSD} = Tm$$

$$3.5.2 \text{ add} = m$$

$$3.5.3 \text{ ded} = 1,157m$$

$$3.5.4 \text{ Vryruimte} = 0,157m$$

$$3.5.5 \text{ BD} = \text{SSD} + 2 \text{ add}$$

$$3.5.6 \text{ T} = \frac{\text{SSD}}{m}$$

$$3.5.7 \text{ BD} = m(T + 2)$$

$$3.5.8 \text{ m} = \frac{\text{BD}}{T + 2}$$



## INFORMATION SHEET

1. Gears for milling machine

Standard and special gear wheels.

24 (two of); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 and 100 teeth.

2. Index plate for milling machine

24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 52; 54; 57; 58; 59; 62 and 66 holes.

3. Formulae

$$3.1 \quad \text{Stress} = \frac{F}{A}$$

$$3.2 \quad \text{Cross-sectional area of solid cylinder} = \frac{\pi}{4} D^2$$

$$3.3 \quad \text{Cross-sectional area of hollow cylinder} = \frac{\pi(D^2 - d^2)}{4}$$

$$3.4 \quad \text{Fluid pressure in a hydraulic press: } \frac{F1}{A1} = \frac{F2}{A2}$$

$$\begin{aligned} \text{Volume of fluid displaced by plunger} &= \text{volume displaced by piston} \\ \text{volume} &= \text{area} \times L \end{aligned}$$

## 3.5 Spur gears:

$$3.5.1 \quad \text{PCD} = Tm$$

$$3.5.2 \quad \text{add} = m$$

$$3.5.3 \quad \text{ded} = 1,157_m$$

$$3.5.4 \quad \text{Clearance} = 0,157_m$$

$$3.5.5 \quad \text{OD} = \text{PCD} + 2 \text{ add}$$

$$3.5.6 \quad T = \frac{\text{PCD}}{m}$$

$$3.5.7 \quad \text{OD} = m(t + 2)$$

$$3.5.8 \quad m = \frac{\text{OD}}{T + 2}$$

$$3.5.9 \text{ Koordaddendum} = m + \left[ \frac{mT}{2} \left( 1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.5.10 \text{ Koorddikte} = mT \sin \frac{90^\circ}{T}$$

$$3.5.11 \text{ Sirkelsteek} = \pi m$$

### 3.6 Heliese tandratte

$$3.6.1 \text{ SSD} = Tm_w$$

$$3.6.2 \text{ add} = m_n$$

$$3.6.3 \text{ ded} = 1,157 m_n$$

$$3.6.4 \text{ Vryruimte} = 0,157 m_n$$

$$3.6.5 \text{ BD} = \text{SSD} + 2 \text{ add}$$

$$3.6.6 \text{ T} = \frac{\text{SSD}}{m_w}$$

$$3.6.7 \text{ } m_n = m_w \cos \theta$$

3.6.8 Getal tande gemerk op die freessnyer:

$$\text{Getal} = \frac{T}{(\cos \theta)^3}$$

$$3.6.9 \text{ Koordaddendum} = m_n + \left[ \frac{m_n T}{2} \left( 1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.6.10 \text{ Koorddikte} = m_n T \sin \frac{90^\circ}{T}$$

$$3.6.11 \text{ Styging van heliks} : \ell = \pi \times \text{SSD} \times \cot \theta$$

of

$$\ell = \frac{\pi \times \text{SSD}}{\tan \theta}$$

$$3.6.12 \text{ Helikshoek} : \tan \theta = \frac{\pi \times \text{SSD}}{\ell}$$

$$3.6.13 \text{ Sirkelsteek} = \pi m_n$$

3.6.14 Styging van freesmasjien = Verdeelkopverhouding x leiskroefsteek

$$3.6.15 \text{ Wisselratte nodig} \frac{Dr}{G} = \frac{L}{\ell}$$

- 3.5.9 Chordal addendum =  $m + \left[ \frac{mT}{2} \left( 1 - \cos \frac{90^\circ}{T} \right) \right]$
- 3.5.10 Chordal width =  $mt \sin \frac{90^\circ}{T}$
- 3.5.11 Circular pitch =  $\pi m$
- 3.6 Helical gears
- 3.6.1 PCD =  $Tm_w$
- 3.6.2 add =  $m_n$
- 3.6.3 ded =  $1,157 m_n$
- 3.6.4 clearance =  $0,157 m_n$
- 3.6.5 OD =  $PCD + 2 \text{ add}$
- 3.6.6 T =  $\frac{PCD}{m_c}$
- 3.6.7  $m_n$  =  $m_c \cos \theta$
- 3.6.8 Number of teeth marked on the milling cutter;
- Number =  $\frac{T}{(\cos \theta)^3}$
- 3.6.9 Chordal addendum =  $m_n + \left[ \frac{m_n T}{2} \left( 1 - \cos \frac{90^\circ}{T} \right) \right]$
- 3.6.10 Chordal thickness =  $m_n T \sin \frac{90^\circ}{T}$
- 3.6.11 Lead of helix :  $\ell = \pi \times PCD \times \cot \theta$   
or  
 $\ell = \frac{\pi \times PCD}{\tan \theta}$
- 3.6.12 Helix angle :  $\tan \theta = \frac{\pi \times PCD}{\ell}$
- 3.6.13 Circular pitch =  $\pi m_n$
- 3.6.14 Lead of milling machine = Dividing head ratio x pitch of leadscrew
- 3.6.15 Change gears required  $\frac{Dr}{G} = \frac{L}{\ell}$

## 3.7 Indeksering:

$$3.7.1 \text{ Eenvoudige indeksering} = \frac{40}{N}$$

$$3.7.2 \text{ Hoekige indeksering} = \frac{\theta}{9^{\circ}}$$

$$3.7.3 \text{ Differensiaalindeksering} = \frac{Dr}{G} = \frac{(A-N)}{A} \times \frac{40}{1}$$

## 3.7.4 Tandstang:

$$\text{Indeksering} = \frac{\text{Verdeelkopverhouding}}{\text{Leiskroefsteek}} \times \frac{\text{Tandstangsteek}}{\text{Ratverhouding}}$$

## 3.8 Slyp van freessnyertande:

$$3.8.1 \text{ Gewone slypwiël : Oorstelling} = R \sin \theta.$$

$$3.8.2 \text{ Komvormige slypwiël: Oorstelling} = r \sin \theta.$$

## 3.9 Grafiese oplossing van statiese balansering:

Uit-balans-uit-effek = Massa X afstand wat massa van middelpunt van vlakplaat af

## 3.10 Beitelhoeke vir die sny van vierkantige skroefdrade:

$$3.10.1 \text{ Helikshoek: } \tan \eta = \frac{\text{Styging}}{\pi D_m}$$

$$3.10.2 \text{ Ingryphoek} = 90^{\circ} - (\text{Helikshoek} + \text{Vryloophoek})$$

$$3.10.3 \text{ Nasleefhoek} = 90^{\circ} + (\text{Helikshoek} - \text{Vryloophoek})$$

## 3.7 Indexing:

$$3.7.1 \text{ Simple indexing} = \frac{40}{N}$$

$$3.7.2 \text{ Angular indexing} = \frac{\theta}{9^\circ}$$

$$3.7.3 \text{ Differential indexing} = \frac{Dr}{G} = \frac{(A-N)}{A} \times \frac{40}{1}$$

## 3.7.4 Rack:

$$\text{Indexing} = \frac{\text{Dividing head ratio}}{\text{Pitch of lead screw}} \times \frac{\text{Pitch of rack}}{\text{Gear ratio}}$$

## 3.8 Grinding of milling cutter teeth:

3.8.1 Disc grinding wheel: Offset = R sin  $\theta$ .3.8.2 Cup wheel: Offset = r sin  $\theta$ .

## 3.9 Graphical solution of static balancing:

Out-of-balance effect = Mass X distance of mass from centre of face plate.

## 3.10 Tool angles for cutting square threads:

$$3.10.1 \text{ Helix angle: } \tan \eta = \frac{\text{Lead}}{\pi D_m}$$

3.10.2 Leading tool angle =  $90^\circ - (\text{Helix angle} + \text{Clearance angle})$ 3.10.3 Following tool angle =  $90^\circ + (\text{Helix angle} - \text{Clearance angle})$