GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE-EKSAMEN
GRADE/*GRAAD* 12
2025

MECHANICAL TECHNOLOGY:
MEGANIESE TEGNOLOGIE:
FITTING AND MACHINING
PASWERK EN MASJINERING

MECHANICAL TECHNOLOGY: Fitting and Machining/MEGANIESE TEGNOLOGIE: Pas en Masjinering

C2200F

TIME/*TYD*: 3 hours/*uur*
MARKS/*PUNTE*: 200
16 pages + a 6-page formula sheet
16 bladsye + 'n 6-bladsy formuleblad

X05

INSTRUCTIONS AND INFORMATION

1. Write your name and surname on the ANSWER BOOK.
2. Read ALL the questions carefully.
3. Answer ALL the questions.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Start EACH question on a NEW page.
6. Show ALL calculations and units. Round-off final answers to TWO decimal places.
7. Candidates may use non-programmable scientific calculators and drawing instruments.
8. The value of gravitational acceleration should be taken as 9,81 m/s^2 or 10 m/s^2.
9. All dimensions are in millimetres, unless stated otherwise.
10. Write neatly and legibly.
11. A 6-page formula sheet is attached to the question paper.
12. Use the criteria below to assist you with your time management.

QUESTION	CONTENT	MARKS	TIME (in minutes)
GENERIC			
1	Multiple-choice questions	6	6
2	Safety	18	18
SPECIFIC			
3	Multiple-choice questions	14	10
4	Terminology (Lathe and Milling Machine)	32	27
5	Terminology (Indexing)	33	29
6	Tools and Equipment	26	24
7	Forces	45	42
8	Maintenance	26	24
	TOTAL	**200**	**180**

INSTRUKSIES EN INLIGTING

1. Skryf jou naam en van op die ANTWOORDBOEK
2. Lees AL die vrae aandagtig deur.
3. Beantwoord AL die vrae.
4. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik word.
5. Begin ELKE vraag op 'n NUWE bladsy.
6. Toon ALLE berekeninge en eenhede. Rond finale antwoorde tot TWEE desimale plekke af.
7. Kandidate mag nie-programmeerbare wetenskaplike sakrekenaars en tekeninstrumente gebruik.
8. Die waarde van gravitasieversnelling moet as 9,81 m/s2 of 10 m/s2 geneem word.
9. Alle afmetings is in millimeter, tensy anders vermeld.
10. Skryf netjies en leesbaar.
11. 'n Formuleblad is aan die vraestel aangeheg.
12. Gebruik die kriteria hieronder om jou met jou tydsbestuur te help.

VRAAG	INHOUD	PUNTE	TYD (in minute)
GENERIES			
1	Meervoudigekeuse-vrae	6	6
2	Veiligheid	18	18
SPESIFIEK			
3	Meervoudigekeuse-vrae	14	10
4	Terminologie (Draaibank en Freesmasjien)	32	27
5	Terminologie (Indeksering)	33	29
6	Gereedskap en Toerusting	26	24
7	Kragte	45	42
8	Instandhouding	26	24
	TOTAAL	**200**	**180**

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question numbers (1.1 to 1.6) in the ANSWER BOOK, e.g. 1.7 E.

1.1 What is the function of the rear light curtain on a power-driven guillotine?

A To screen the operator from metal debris
B To prevent entry from the rear of the machine
C To screen the operator from the blades
D To allow the operator to work at a distance from the point of operation (1)

1.2 What is the maximum distance allowed between the tool rest and the grinding disc on a bench grinder?

A 1 mm
B 3 mm
C 5 mm
D 9 mm (1)

1.3 Which of the following is considered a visible sign or symptom before any action should take place during first aid?

A Glass fragments
B Wet or slippery floors
C Bleeding from the nose or ears
D Pulse (1)

1.4 Which thickness of metal plates should not be exceeded on a manual guillotine during cutting operations?

A 1,0 mm
B 1,2 mm
C 2,0 mm
D 3,4 mm (1)

1.5 At what height above the top of the material should the blade guard on a band saw be set?

A 9 mm
B 7 mm
C 3 mm
D 1 mm (1)

VRAAG 1: MEERVOUDIGEKEUSE-VRAE (GENERIES)

Verskeie opsies word as moontlike antwoorde vir die volgende vrae gegee. Kies die antwoord en skryf slegs die letter (A – D) langs die vraagnommers neer (1.1 tot 1.6) in die ANTWOORDBOEK, bv. 1.7 E.

1.1 Wat is die funksie van die agterliggordyn op 'n kragaangedrewe guillotine?

A Om die operateur van metaalafval te skerm
B Om toegang van die agterkant van die masjien te voorkom
C Om die operateur van die lemme af te skerm
D Om die operateur toe te laat om op 'n afstand van die punt van werk te werk (1)

1.2 Wat is die maksimum afstand wat toegelaat word tussen die gereedskaprus en die slypskyf op 'n bankslyper?

A 1 mm
B 3 mm
C 5 mm
D 9 mm (1)

1.3 Watter van die volgende word as ’n sigbare teken of simptoom beskou voordat enige aksie tydens noodhulp moet plaasvind?

A Glasfragmente
B Nat of gladde vloere
C Bloeding van die neus of ore
D Pols (1)

1.4 Watter dikte van metaalplate moet nie oorskry word op 'n handguillotine tydens snywerk nie?

A 1,0 mm
B 1,2 mm
C 2,0 mm
D 3,4 mm (1)

1.5 Op watter hoogte bokant die boonste oppervlakte van die materiaal moet die lemskerm op 'n bandsaag gestel word?

A 9 mm
B 7 mm
C 3 mm
D 1 mm (1)

1.6 Why should oil or grease not come into contact with the oxygen fittings on oxy-acetylene cylinders?

A It forms a flammable mixture.
B It makes the fittings slippery.
C Dust clings to the fittings.
D It is difficult to tighten the fittings properly. (1)

[6]

QUESTION 2: SAFETY (GENERIC)

2.1 State TWO safety precautions that must be adhered to after the following machines have been switched on:

2.1.1 Angle grinder (2)

2.1.2 Drill press (2)

2.2 State TWO advantages of the process workshop layout. (2)

2.3 State TWO disadvantages of the product workshop layout. (2)

2.4 State TWO electrical safety precautions that must be observed before a portable grinder can be switched on. (2)

2.5 Give TWO reasons why revolving warning lights are used on a power-driven guillotine. (2)

2.6 Give TWO reasons why a two-hand control device is used on a power-driven guillotine. (2)

2.7 What should never be exceeded when using a hydraulic press? (1)

2.8 State THREE actions that must take place before any welding operations can begin in the mechanical workshop. (3)

[18]

1.6 Hoekom moet olie of ghries nie met die suurstoftoebehore op oksi-asetileensilinders in aanraking kom nie?

A Dit vorm 'n vlambare mengsel.
B Dit maak die toebehore glad.
C Stof kleef aan die toebehore.
D Dit is moeilik om die toebehore behoorlik vas te maak. (1)

[6]

VRAAG 2: VEILIGHEID (GENERIES)

2.1 Noem TWEE veiligheidsmaatreëls wat nagekom moet word nadat die volgende masjiene aangeskakel is:

2.1.1 Hoekslyper (2)

2.1.2 Staanboor (2)

2.2 Noem TWEE voordele van die proses-werkswinkeluitleg. (2)

2.3 Noem TWEE nadele van die produk-werkswinkeluitleg. (2)

2.4 Noem TWEE elektriese veiligheidsmaatreëls wat nagekom moet word voordat 'n draagbare slypmasjien aangeskakel kan word. (2)

2.5 Gee TWEE redes waarom draaiende waarskuwingsligte op 'n kragaangedrewe guillotine gebruik word. (2)

2.6 Gee TWEE redes waarom 'n tweehandbeheertoestel op 'n kragaangedrewe guillotine gebruik word. (2)

2.7 Wat moet nooit oorskry word wanneer 'n hidrouliese pers gebruik word nie? (1)

2.8 Noem DRIE aksies wat moet plaasvind voordat enige sweiswerk in die meganiese werkswinkel kan begin. (3)

[18]

QUESTION 3: MULTIPLE CHOICE QUESTIONS (SPECIFIC)

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question numbers (3.1 to 3.14) in the ANSWER BOOK, e.g. 3.15 E.

3.1 Which of the following statements is correct for the centre lathe machine component in FIGURE 3.1 below?

FIGURE 3.1

A It is used to do centre drilling.
B It supports the workpiece.
C It helps to set up the graduated collar.
D It is a dead centre. (1)

3.2 Which of the following devices is used to machine multi-start screw thread?

A Graduated collar
B Centre gauge
C Thread-pitch gauge
D Live centre (1)

3.3 Which type of cutter below is specifically designed to cut a keyway at a precise distance from the shaft end?

A Helical cutter
B Flute mill
C Shell mill
D Involute gear tooth cutter (1)

3.4 The magnitude of the centrifugal force is determined by the ...

A mass of the rotating element.
B specific tool that is used.
C amount of braking power applied to the workpiece.
D extent to which the mass is on centre. (1)

VRAAG 3: MEERVOUDIGEKEUSE-VRAE (SPESIFIEK)

Verskeie opsies word as moontlike antwoorde vir die volgende vrae gegee. Kies 'n antwoord en skryf slegs die letter (A – D) langs die vraagnommer neer(3.1 tot 3.14) in jou ANTWOORDBOEK, bv. 3.15 E.

3.1 Watter van die volgende stellings is korrek vir die senterdraaibank-masjienkomponent in FIGUUR 3.1 hieronder?

FIGUUR 3.1

A Dit word gebruik om senterboorwerk te doen.
B Dit ondersteun die werkstuk.
C Dit help om die gegradueerde kraag op te stel.
D Dit is ’n dooie/vaste senter. (1)

3.2 Watter van die volgende toestelle word gebruik om meervoudige-skroefdraad te masjineer?

A Gegradueerde kraag
B Skroefdraadsentermaat
C Skroefdraadsny-wyserplaat
D Draaiende sentrum (1)

3.3 Watter tipe snyer hieronder is spesifiek ontwerp om 'n spygleuf op 'n presiese afstand van die aspunt af te sny?

A Heliese snyer
B Groefsnyer
C Skulpfreessnyer
D Involuterat-tandsnyer (1)

3.4 Die grootte van die sentrifugale krag word bepaal deur die ...

A massa van die roterende element.
B spesifieke instrument wat gebruik word.
C hoeveelheid remkrag wat op die werkstuk toegepas word.
D mate waarin die massa in die middel is. (1)

3.5 Absolute motion during CNC milling is measured from …

A the last position of the cutting tool.
B the beginning of the workpiece.
C a common point.
D the middle of the workpiece. (1)

3.6 What does the abbreviation CNC stand for?

A Computer naming control
B Computer negative control
C Computer neutral control
D Computer numerical control (1)

3.7 The tool used to measure the depth of a workpiece accurately, is called a …

A depth micrometer.
B screw-cutting dial.
C screw-thread micrometer.
D centre gauge. (1)

3.8 Identify the precision tool that is used to measure the length of a cylinder:

A Outside micrometer
B Inside micrometer
C Depth micrometer
D Screw-thread micrometer (1)

3.9 To what type of stress are the rivets in FIGURE 3.9 below, subjected?

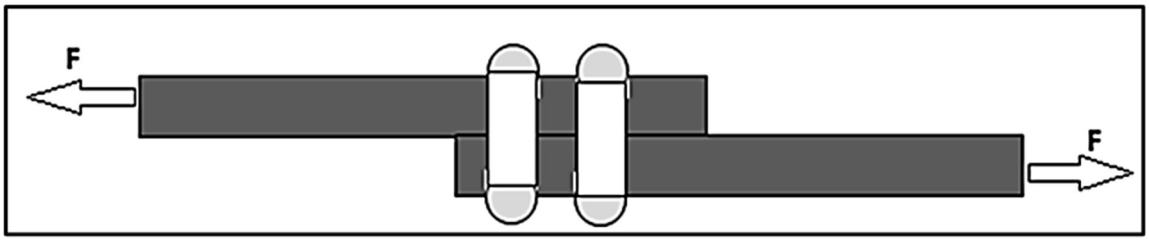


FIGURE 3.9

A Tensile stress
B Compressive stress
C Shear stress
D Pushing stress (1)

3.5 Absolute beweging tydens CNC-freeswerk word gemeet vanaf ...

A die laaste posisie van die snygereedskap.
B die begin van die werkstuk.
C 'n algemene punt.
D die middel van die werkstuk. (1)

3.6 Waarvoor staan die afkorting CNC?

A Rekenaar-naambeheerde
B Rekenaar-negatiefbeheerde
C Rekenaar-neutraalbeheerde
D Rekenaar-numeriesbeheerde (1)

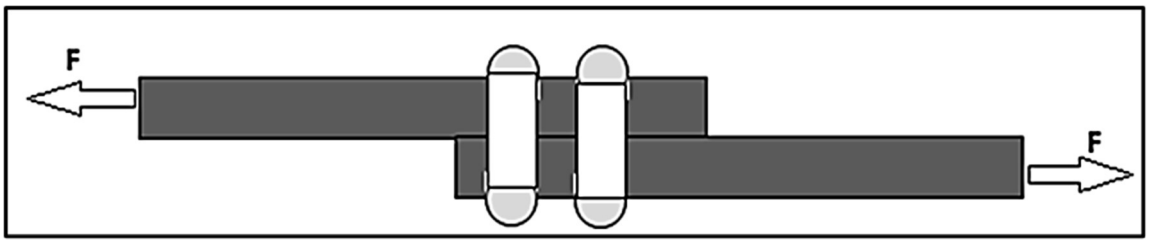
3.7 Die gereedskap wat gebruik word om die diepte van 'n werkstuk akkuraat te meet, word genoem ‘n ... genoem.

A dieptemikrometer
B skroefsnymeter
C skroefdraadmikrometer
D sentermeter (1)

3.8 Identifiseer die presisie-instrument wat gebruik word om die lengte van 'n silinder te meet:

A Buitemikrometer
B Binnemikrometer
C Dieptemikrometer
D Skroefdraadmikrometer (1)

3.9 Aan watter tipe spanning word die klinknaels in FIGUUR 3.9 hieronder onderwerp?



FIGUUR 3.9

A Trekspanning
B Drukspanning
C Skuifspanning
D Stootspanning (1)

3.10 What is understood by the term Young's modulus of elasticity?

A The force value required to produce a unit area in a tensile test specimen
B A measurement of the extension or contraction of a material due to the load experienced
C A ratio of the deformation caused by the application of an external force
D The ratio between stress and strain in a metal, provided that the limit of elasticity is not exceeded (1)

3.11 What does the term *stress* mean?

A It is an indication of the reluctance of a body to move.
B It is the internal resistance in a body to an external load.
C It is an external force acting upon matter.
D It is the change in length of a material under a load. (1)

3.12 Which of the following statements is considered an advantage of nylon?

A It is not affected by direct sunlight.
B It has a high coefficient of friction.
C It wears easily.
D It is not affected by fungi. (1)

3.13 Which of the following materials is used in the manufacturing of brake linings?

A Carbon fibre
B Vesconite
C Bakelite
D Glass fibre (1)

3.14 Which mechanical component is best suited to be manufactured from Vesconite?

A Joints
B Bearings
C Pyrometer
D Distributor (1)

[14]

3.10 Wat word verstaan met die term Young se elastisiteitsmodulus?

A Die kragwaarde wat nodig is om 'n eenheidsoppervlakte in 'n trektoetsmonster te produseer
B 'n Meting van die verlenging of inkrimping van materiaal as gevolg van die las wat ervaar word
C 'n Verhouding van die vervorming as gevolg van die toepassing van 'n eksterne krag
D Die verhouding tussen spanning en vervorming in 'n metaal, mits die grens van elastisiteit nie oorskry word nie (1)

3.11 Wat beteken die term *spanning* ?

A Dit is 'n aanduiding van die weerstand/reluktansie van 'n liggaam om te beweeg.
B Dit is die interne weerstand in 'n liggaam teen 'n eksterne las.
C Dit is 'n eksterne krag wat op materie inwerk.
D Dit is die verandering in lengte van 'n materiaal onderhewig aan 'n las. (1)

3.12 Watter van die volgende stellings word as 'n voordeel van nylon beskou?

A Dit word nie deur direkte sonlig beïnvloed nie.
B Dit het 'n hoë wrywingskoëffisiënt.
C Dit verweer maklik.
D Dit word nie deur swamme beïnvloed nie. (1)

3.13 Watter van die volgende materiale word gebruik in die vervaardiging van remvoerings?

A Koolstofvesel
B Vesconite
C Bakeliet
D Glasvesel (1)

3.14 Watter meganiese komponent is die beste geskik om van Vesconite vervaardig te word?

A Lasse
B Laers
C Pirometer
D Vonkverdeler (1)

[14]

QUESTION 4: TERMINOLOGY (LATHE AND MILLING MACHINE) (SPECIFIC)

4.1 Name TWO advantages of the tailstock set-over method of cutting tapers. (2)

4.2 FIGURE 4.2 below shows a taper that must be machined between two centres, with an included angle of 13°.

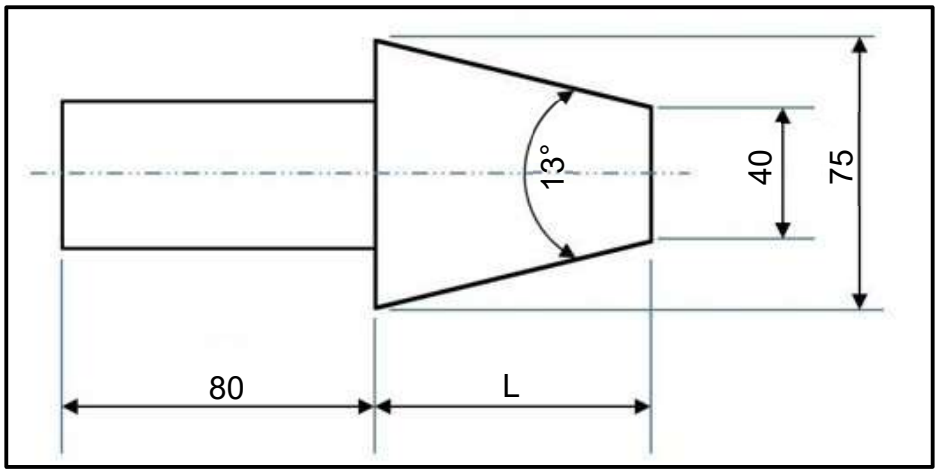


FIGURE 4.2

Calculate the following:

4.2.1 The length of the taper (4)

4.2.2 The set-over of the tailstock required to cut the taper (3)

4.3 Explain the usage of a thread-pitch gauge. (2)

4.4 A parallel key must be machined for a 78 mm drive shaft. Calculate the following:

4.4.1 Width (2)

4.4.2 Thickness (2)

4.4.3 Length (2)

4.5 Answer the following questions regarding the milling process.

4.5.1 State THREE advantages of up-cut milling. (3)

4.5.2 State THREE disadvantages of down-cut milling. (3)

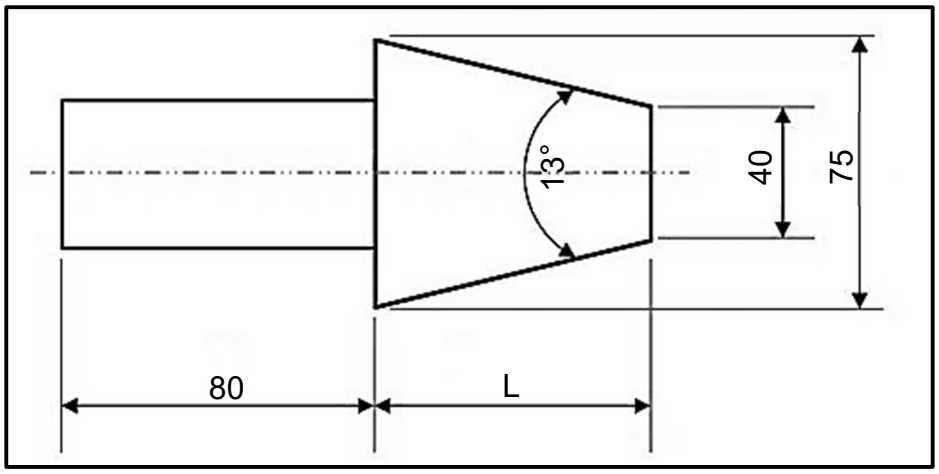
4.5.3 Give TWO disadvantages of straddle milling. (2)

4.5.4 Name TWO advantages of gang milling. (2)

VRAAG 4: TERMINOLOGIE (DRAAIBANK EN FREESMASJIEN) (SPESIFIEK)

4.1 Noem TWEE voordele van die loskopoorstellingsmetode om tapse te sny. (2)

4.2 FIGUUR 4.2 toon 'n taps wat tussen twee senters gemasjineer moet word, met 'n ingeslote hoek van 13°.



FIGUUR 4.2

Bereken die volgende:

4.2.1 Die lengte van die taps (4)

4.2.2 Die oorstelling van die loskop wat nodig is om die taps te sny (3)

4.3 Verduidelik die gebruik van 'n skroefdraadsteekmeter. (2)

4.4 'n Parallellspy moet vir 'n 78 mm dryfas gemasjineer word. Bereken die volgende:

4.4.1 Breedte (2)

4.4.2 Dikte (2)

4.4.3 Lengte (2)

4.5 Beantwoord die volgende vrae rakende die freesproses.

4.5.1 Noem DRIE voordele van opfreeswerk. (3)

4.5.2 Noem DRIE nadele van affreeswerk. (3)

4.5.3 Gee TWEE nadele van koppelfreeswerk. (2)

4.5.4 Noem TWEE voordele van groepfreeswerk. (2)

4.6 State TWO methods that can be used to centre a milling cutter. (2)

4.7 State TWO safety precautions that must be observed before the lathe machine is switched on. (2)

4.8 Why must the operator wear goggles when cutting brass on a machine? (1)
[32]

QUESTION 5: TERMINOLOGY (INDEXING) (SPECIFIC)

5.1 Dean is a machinist and is tasked to cut a spur gear with a pitch-circle diameter of 120 mm and a module of 3. Calculate the following:

5.1.1 Number of teeth (3)

5.1.2 Dedendum (2)

5.1.3 Outside diameter (2)

5.1.4 Circular pitch (2)

5.2 FIGURE 5.2 below shows an internal dovetail that must be manufactured for a tool holder on a lathe machine.

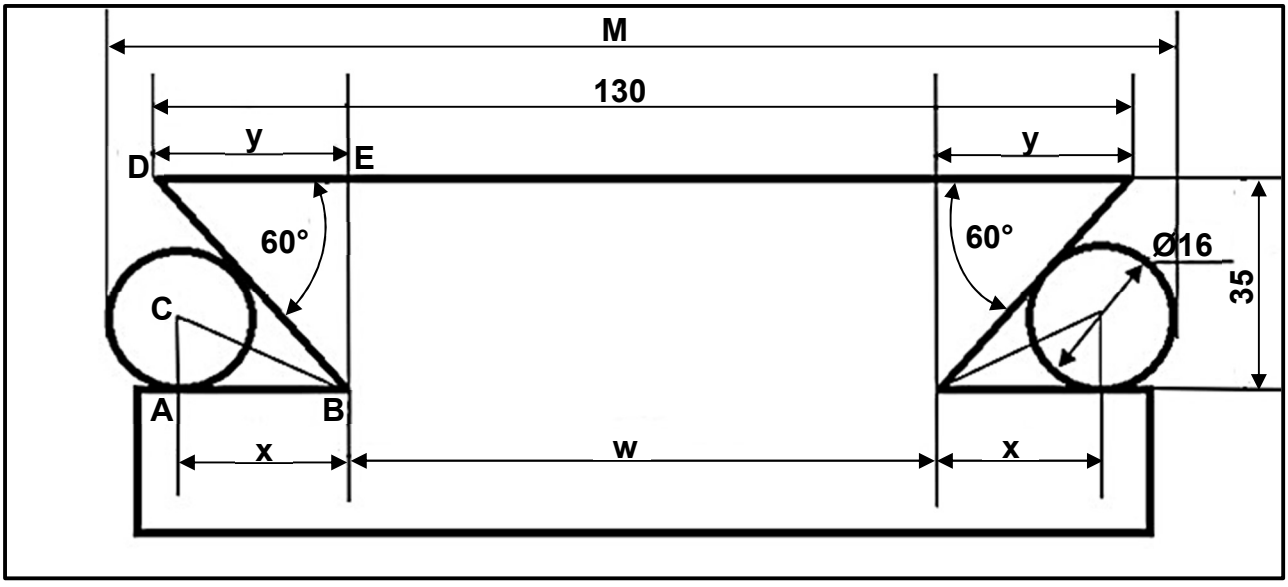


FIGURE 5.2

Calculate the following:

5.2.1 The minimum width (w) of the dovetail (6)

5.2.2 The distance (M) across the rollers (6)

4.6 Noem TWEE metodes wat gebruik kan word om 'n freessnyer te sentreer. (2)

4.7 Noem TWEE veiligheidsmaatreëls wat in ag geneem moet word voordat die draaibankmasjien aangeskakel word. (2)

4.8 Waarom moet die operateur 'n bril dra wanneer hy geelkoper op 'n masjien sny? (1)

[32]

VRAAG 5: TERMINOLOGIE (INDEKSERING) (SPESIFIEK)

5.1 Dean is 'n masjinis en het die taak om 'n reguittandrat met 'n steeksirkeldeursnee van 120 mm en 'n module van 3 te sny. Bereken die volgende:

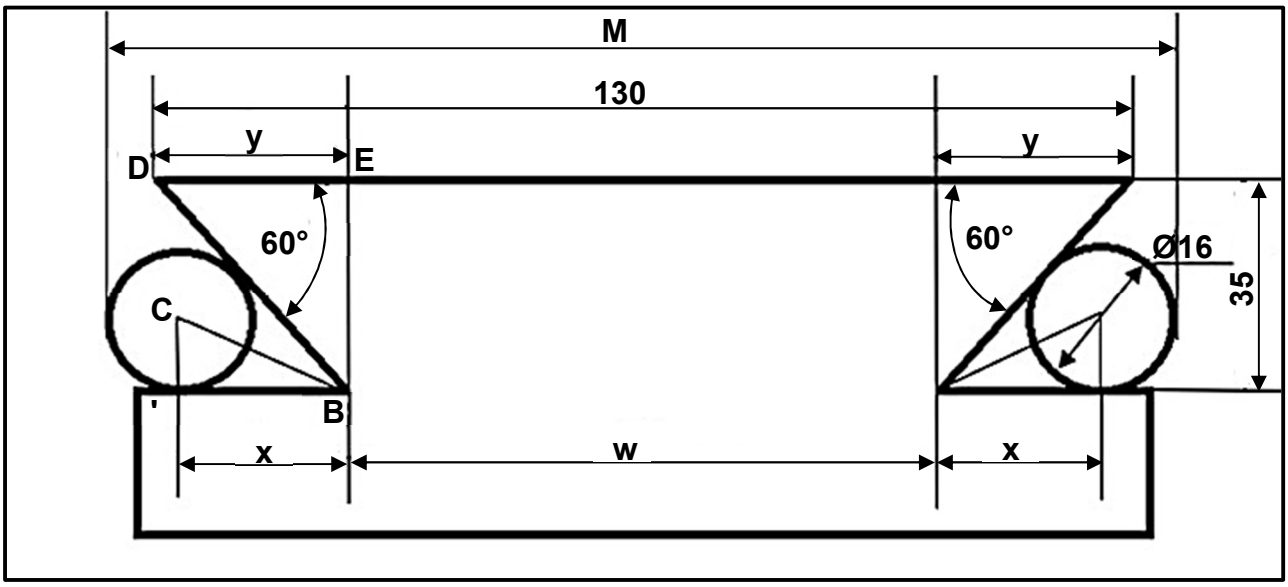
5.1.1 Aantal tande (3)

5.1.2 Dedendum (2)

5.1.3 Buite deursnee (2)

5.1.4 Sirkelsteek (2)

5.2 FIGUUR 5.2 hieronder toon 'n interne swaelstert wat vir 'n beitelhouer op 'n draaibankmasjien vervaardig moet word.



FIGUUR 5.2

Bereken die volgende:

5.2.1 Die minimum wydte (w) van die swaelstert (6)

5.2.2 Die afstand (M) oor die rollers (6)

5.3 Calculate the indexing required to machine two surfaces at an angle of 26° to each other. (3)

5.4 Sarah is required to mill a spur gear with 137 teeth for an engineering client. The dividing head that she is using has a ratio of 40 : 1.

5.4.1 Calculate the indexing that is needed. (Use A = 140) (3)

5.4.2 Calculate the change gears that are required. (4)

5.5 Name TWO types of balancing methods that can be done on a lathe. (2)
[33]

QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)

6.1 Name the different types of indenters used in the following hardness testers:

6.1.1 Rockwell hardness tester (1)

6.1.2 Brinell hardness tester (1)

6.2 FIGURE 6.2 below shows a Rockwell hardness tester. Label **A** – **D**. (4)

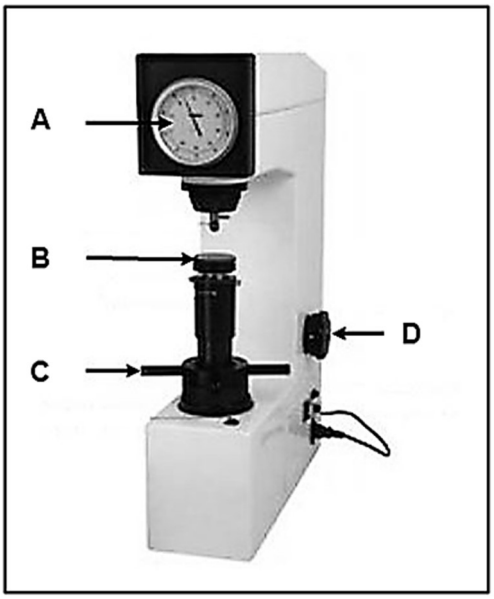


FIGURE 6.2

6.3 Describe the function of the moment tester. (2)

5.3 Bereken die indeksering wat nodig is om twee oppervlaktes teen 'n hoek van 26° tot mekaar te masjineer. (3)

5.4 Daar word van Sarah verwag om 'n reguittandrat met 137 tande vir 'n ingenieurskliënt te frees. Die verdeelkop wat sy gebruik, het 'n verhouding van 40 : 1.

5.4.1 Bereken die indeksering wat nodig is. (Gebruik A = 140) (3)

5.4.2 Bereken die wisselratte wat benodig word. (4)

5.5 Noem TWEE tipes balanseringsmetodes wat op 'n draaibank gedoen kan word. (2)

[33]

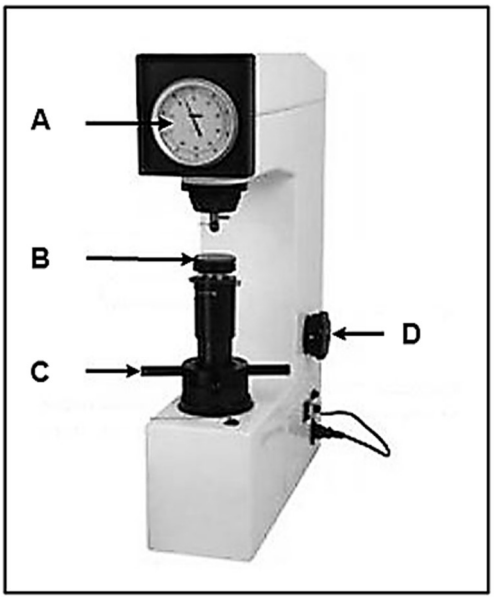
VRAAG 6: GEREEDSKAP EN TOERUSTING (SPESIFIEK)

6.1 Noem die verskillende tipes induikers wat in die volgende hardheidstoetsers gebruik word:

6.1.1 Rockwell-hardheidstoetser (1)

6.1.2 Brinell-hardheidtoetser (1)

6.2 FIGUUR 6.2 hieronder toon 'n Rockwell-hardheidstoetser. Benoem **A** – **D**. (4)



FIGUUR 6.2

6.3 Beskryf die funksie van die moment-toetser. (2)

6.4 Give the reading of the screw thread micrometer in FIGURE 6.4 below, with a 50 – 75 mm extension rod. (3)

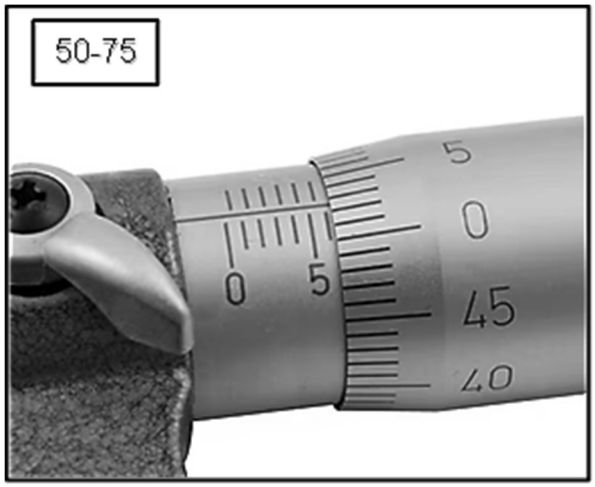


FIGURE 6.4

6.5 Study FIGURE 6.5 below which shows a metric screw thread and answer the questions that follow.

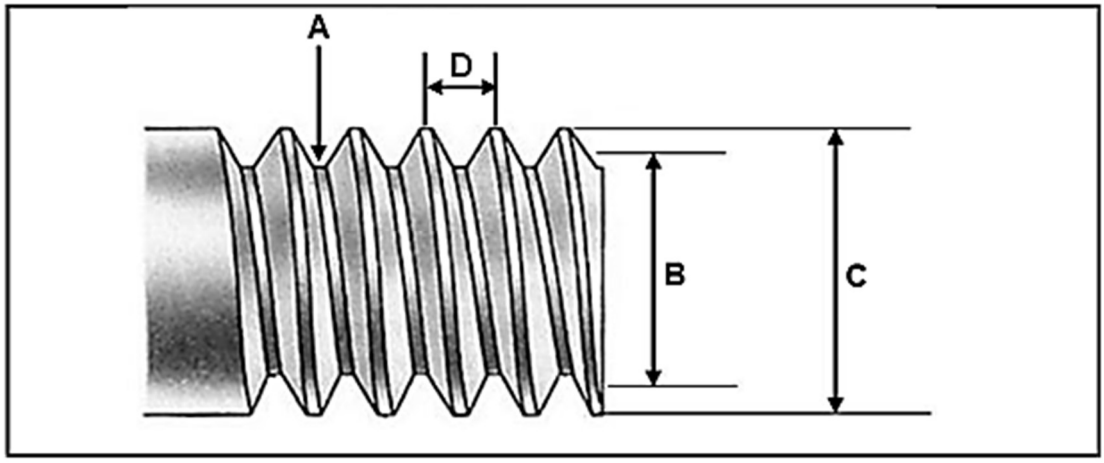


FIGURE 6.5

6.5.1 Label **A** – **D**. (4)

6.5.2 Name TWO instances where V-screw thread can be used in a workshop. (2)

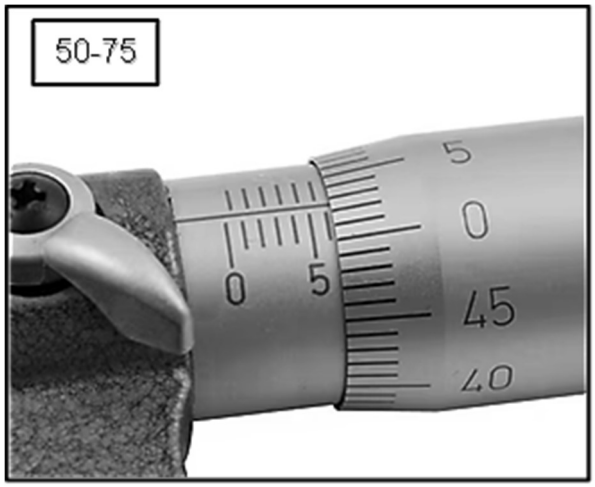
6.6 What is represented by the following in an M12 x 1,75 screw thread?

6.6.1 M (1)

6.6.2 12 (1)

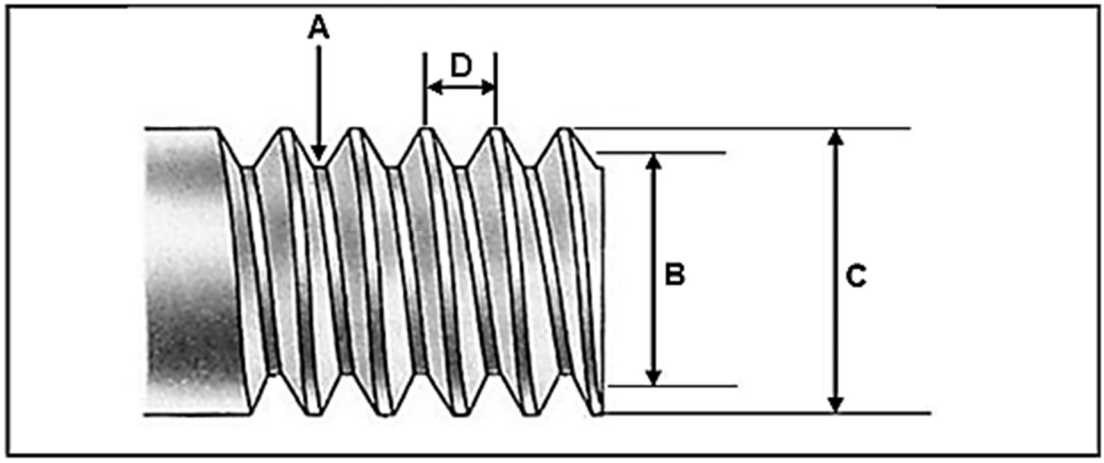
6.6.3 1,75 (1)

6.4 Gee die lesing van die skroefdraadmikrometer in FIGUUR 6.4 hieronder, met 'n verlengstaaf van 50 – 75 mm: (3)



FIGUUR 6.4

6.5 FIGUUR 6.5 hieronder toon 'n metrieke skroefdraad. Beantwoord die vrae wat volg.



FIGUUR 6.5

6.5.1 Benoem **A** – **D**. (4)

6.5.2 Noem TWEE gevalle waar V-skroefdraad in die werkswinkel gebruik kan word. (2)

6.6 Wat word deur die volgende voorgestel in 'n M12 x 1,75 skroefdraad?

6.6.1 M (1)

6.6.2 12 (1)

6.6.3 1,75 (1)

6.7 FIGURE 6.7 below shows a screw thread micrometer. Label **A** – **D**. (4)

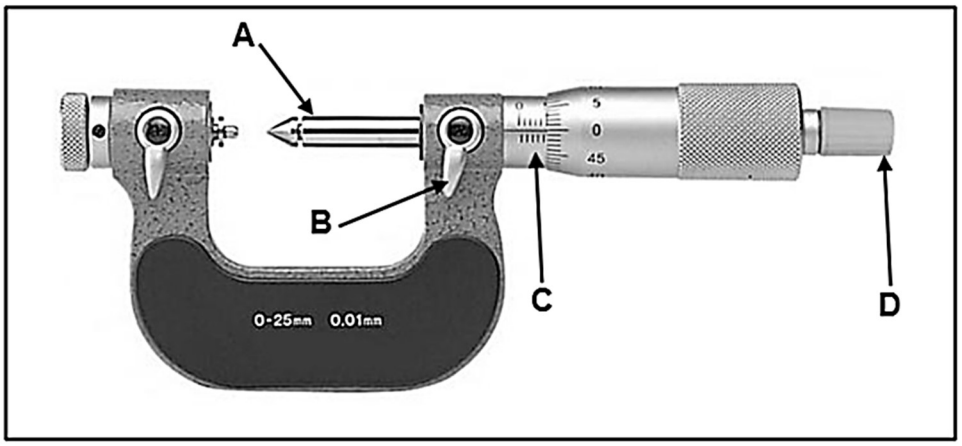
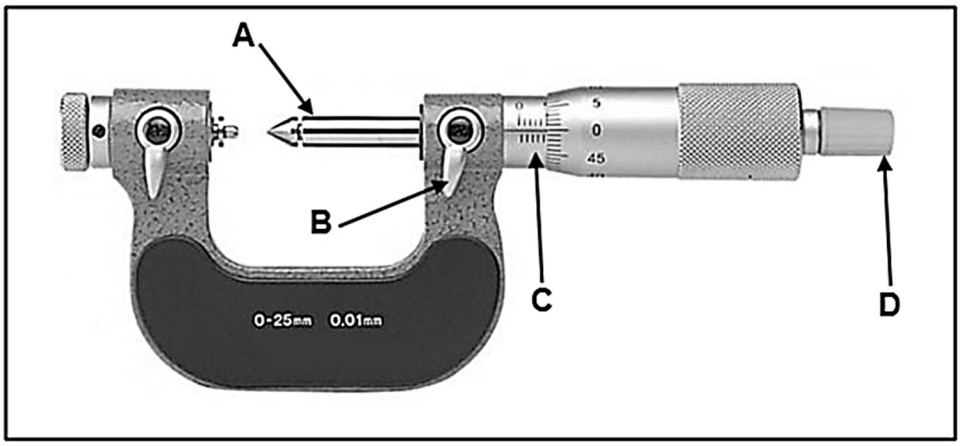


FIGURE 6.7

6.8 Describe the function of a screw thread micrometer. (2)

[26]

6.7 FIGUUR 6.7 hieronder toon 'n skroefdraadmikrometer. Benoem **A** – **D**. (4)



FIGUUR 6.7

6.8 Beskryf die funksie van 'n skroefdraadmikrometer. (2)

[26]

QUESTION 7: FORCES (SPECIFIC)

7.1 Define the following types of forces:

7.1.1 *Resultant* (2)

7.1.2 *Equilibrant* (2)

7.2 FIGURE 7.2 below shows a system of four forces acting on the same point. (**HINT**: Draw and complete the diagram in FIGURE 7.2. Show ALL the horizontal and vertical components before doing the calculations.)

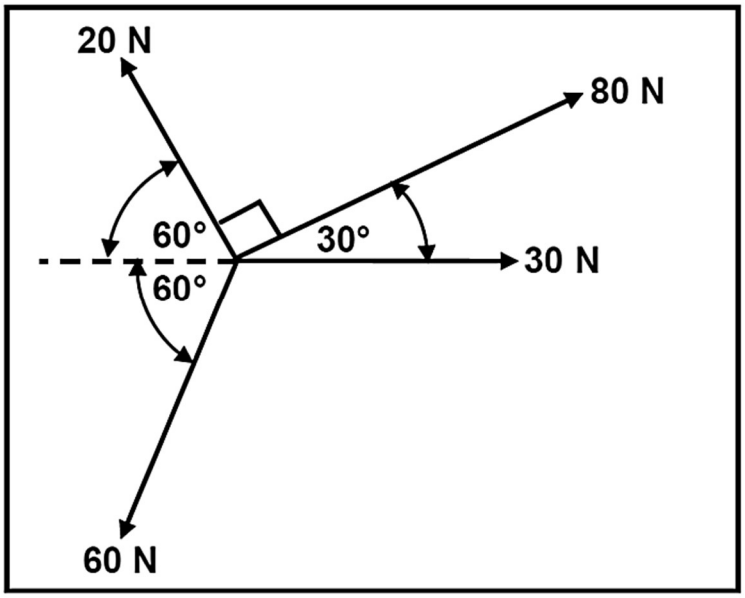


FIGURE 7.2

Calculate the following:

7.2.1 The sum of the horizontal components (5)

7.2.2 The sum of the vertical components (4)

7.2.3 The magnitude of the resultant (2)

7.2.4 The angle and direction of the resultant (3)

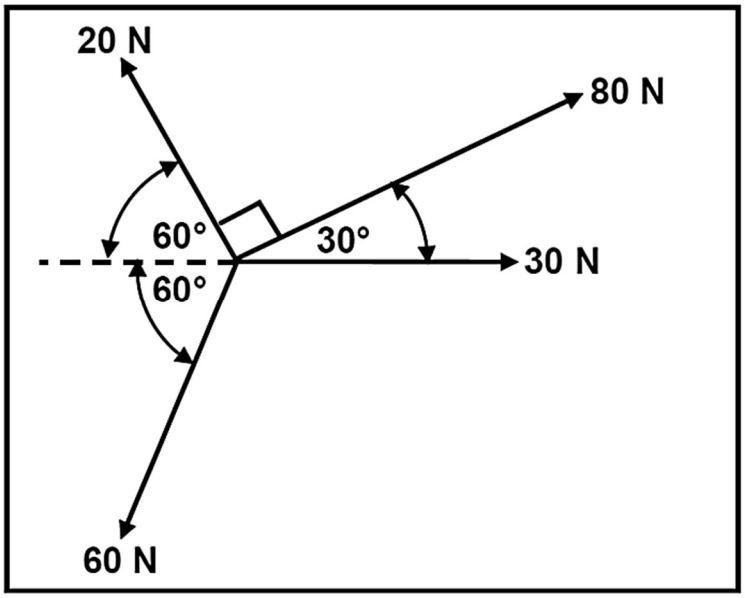
VRAAG 7: KRAGTE (SPESIFIEK)

7.1 Definieer die volgende tipes kragte:

7.1.1 *Resultant* (2)

7.1.2 *Ekwilibrant* (2)

7.2 FIGUUR 7.2 hieronder toon 'n stelsel van vier kragte wat op dieselfde punt inwerk. (**WENK**: Teken en voltooi die diagram in FIGUUR 7.2. Wys AL die horisontale en vertikale komponente voordat die berekeninge gedoen word.)



FIGUUR 7.2

Bereken die volgende:

7.2.1 Die som van die horisontale komponente (5)

7.2.2 Die som van die vertikale komponente (4)

7.2.3 Die grootte van die resultant (2)

7.2.4 Die hoek en rigting van die resultant (3)

7.3 FIGURE 7.3 below shows a beam supported by two vertical supports, **A** and **B**. A vertical point load, as well as a uniformly distributed load of 10 N/m, are exerted onto the beam.

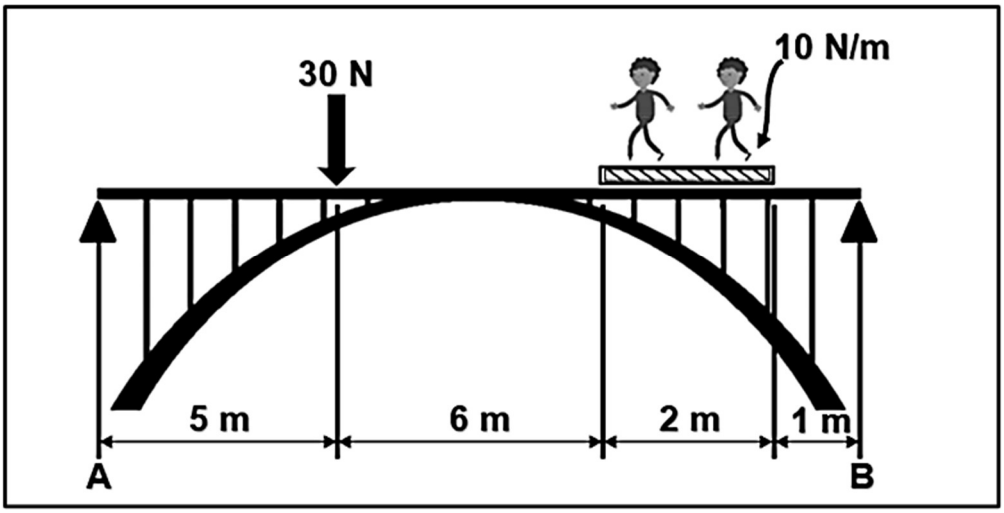


FIGURE 7.3

Calculate the following:

7.3.1 The point load representing the uniformly distributed load (2)

7.3.2 The magnitude of the reaction forces at **A** and **B** (8)

7.4 FIGURE 7.4 shows the stress/strain diagram. Label the points **A** – **D** in the diagram. (4)

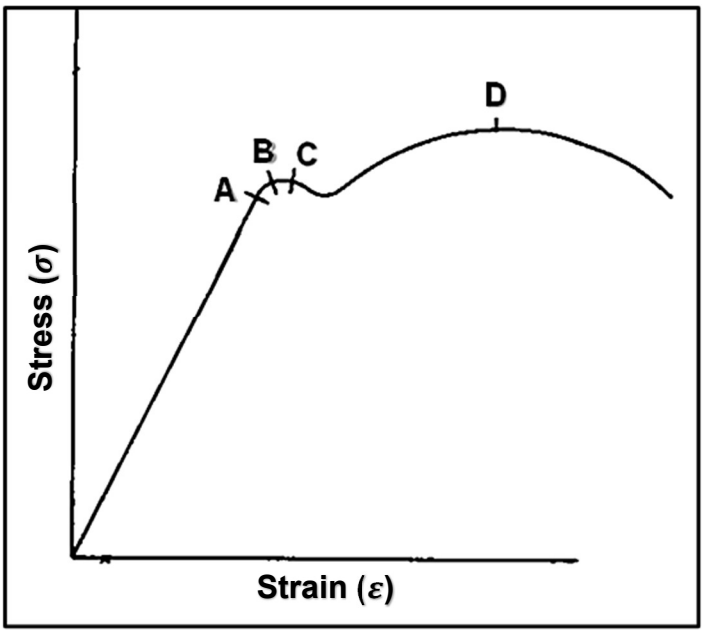
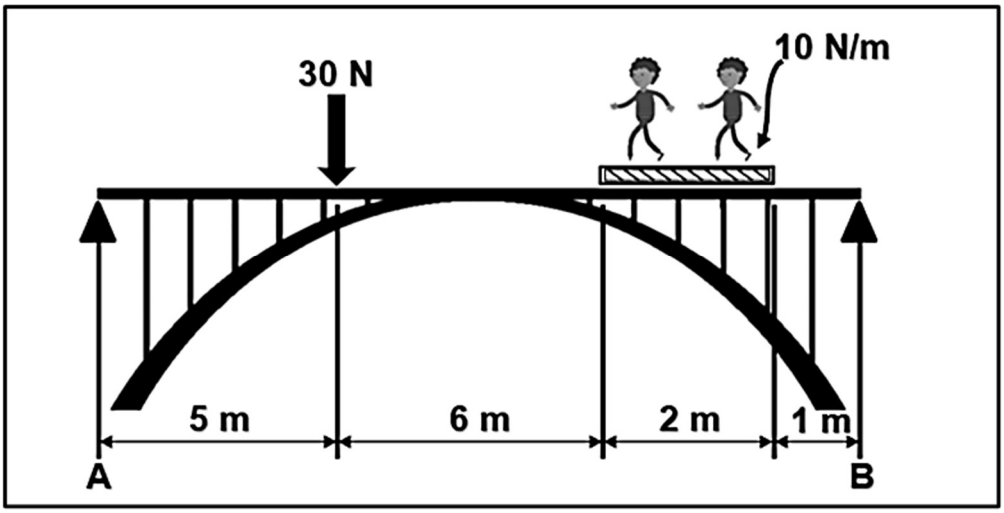


FIGURE 7.4

7.3 FIGUUR 7.3 hieronder toon 'n balk wat ondersteun word deur twee vertikale stutte, **A** en **B**. 'n Vertikale puntlading, sowel as 'n eenvormig verspreide las van 10 N/m, word op die balk uitgeoefen.



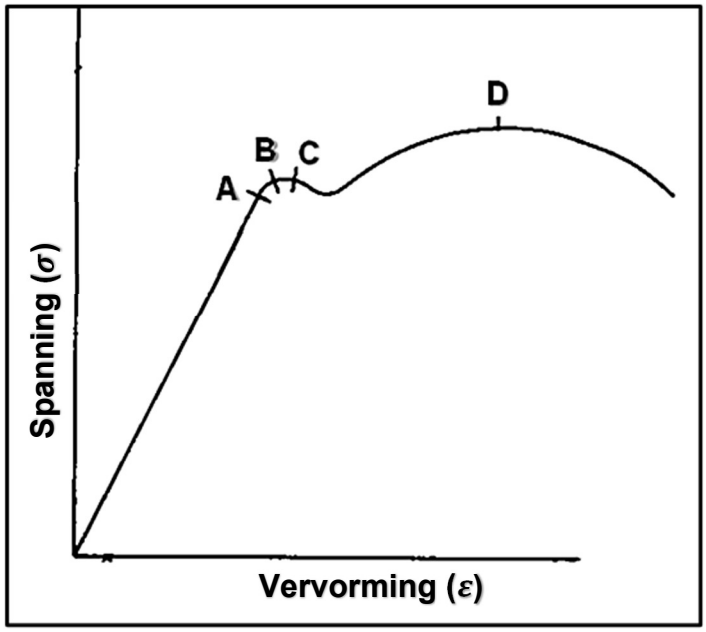
FIGUUR 7.3

Bereken die volgende:

7.3.1 Die puntlading wat die eenvormige verspreide las verteenwoordig. (2)

7.3.2 Die grootte van die reaksiekragte by **A** en **B.** (8)

7.4 FIGUUR 7.4 toon die spanning-/vervormingsdiagram. Benoem die punte **A** – **D** in die diagram. (4)



FIGUUR 7.4

7.5 A steel bar with an original length of 150 mm is used during a tensile test. The strain on the bar is 53,33 x 10^{-3} and Young's modulus for the bar is 12,73 GPa. The force applied was 100 kN.

Calculate the following:

7.5.1 The change in length in **mm** (3)

7.5.2 The stress in **MPa** (3)

7.5.3 The cross-sectional area of the bar (3)

7.5.4 The diameter of the bar in **mm** (4)

[45]

7.5 'n Staalstaaf met 'n oorspronklike lengte van 150 mm word tydens 'n trektoets gebruik. Die vervorming in die staaf is 53,33 x 10^{-3} en Young se modulus vir die staaf is 12,73 GPa. Die krag wat toegepas is, was 100kN.

Bereken die volgende:

7.5.1 Die verandering in lengte in **mm** (3)

7.5.2 Die spanning in **MPa** (3)

7.5.3 Die deursnee-area van die staaf (3)

7.5.4 Die diameter van die staaf in **mm** (4)
[45]

QUESTION 8: MAINTENANCE (SPECIFIC)

8.1 State THREE advantages of belt drives compared to gear drives. (3)

8.2 State THREE serious consequences of failing to conduct preventative maintenance in your workshop. (3)

8.3 State whether the following materials are thermoplastic- or thermo-hardened composites:

8.3.1 Bakelite (1)

8.3.2 Nylon (1)

8.3.3 PVC (1)

8.4 Define the following:

8.4.1 *Thermoplastic compound* (2)

8.4.2 *Thermo-hardened compound* (2)

8.5 State THREE preventative maintenance measures for chain drives. (3)

8.6 State THREE preventative maintenance measures for belt drives. (3)

8.7 State TWO uses for EACH of the following composites in a mechanical workshop:

8.7.1 Nylon (2)

8.7.2 Vesconite (2)

8.7.3 Teflon (2)

8.8 What is the purpose of a jockey pulley in belt drives? (1)

[26]

TOTAL: 200

VRAAG 8: INSTANDHOUDING (SPESIFIEK)

8.1 Noem DRIE voordele van bandaandrywings in vergelyking met rataandrywings. (3)

8.2 Noem DRIE ernstige gevolge van versuim om voorkomende instandhouding in jou werkswinkel uit te voer. (3)

8.3 Noem of die volgende materiale termoplastiese of termo-verharde samestellings is:

8.3.1 Bakeliet (1)

8.3.2 Nylon (1)

8.3.3 PVC (1)

8.4 Definieer die volgende:

8.4.1 *Termoplastiese samestelling* (2)

8.4.2 *Termo-verharde samestelling* (2)

8.5 Noem DRIE voorkomende instandhoudingsmaatreëls vir kettingaandrywings. (3)

8.6 Noem DRIE voorkomende instandhoudingsmaatreëls op bandaandrywings. (3)

8.7 Noem TWEE gebruike vir ELK van die volgende samestellings in 'n meganiese werkswinkel:

8.7.1 Nylon (2)

8.7.2 Vesconite (2)

8.7.3 Teflon (2)

8.8 Wat is die doel van ’n leikatroll (*jockey pulley*) in bandaandrywings? (1)

[26]

TOTAAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY: FITTING AND MACHINING

1. BELT DRIVES

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

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

1.3 *Belt mass = Area × Length × Density (A = thickness × width)*

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

1.5 *Belt length (flat) = [(D + d) × 1,57] + (2 × centre distance)*

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

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

1.8 *Power (P) =* $\frac{(T_1 - T_2)\pi\ D\ N}{60}$

Where:

T_1 = force in the tight side
T_2 = force in the slack side
$T_1 - T_2$ = effective tensile force (T_e)

1.9 *Ratio between tight side and slack side =* $\frac{T_1}{T_2}$

1.10 $Width = \frac{T_1}{Permissible\ tensile\ force}$

1.11 $N_{DR} \times D_{DR} = N_{DN} \times D_{DN}$

1.12 *Torque = Force × Radius*

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

FORMULEBLAD VIR MEGANIESE TEGNOLOGIE: PASWERK EN MASJINERING

1. BANDAANDRYWINGS

1.1 *Bandspoed* = $\frac{\pi DN}{60}$

1.2 *Bandspoed* = $\frac{\pi\ (D\ +\ t)\times N}{60}$ *(T = geslote dikteer)*

1.3 *Bandmassa = Area ×Lengte × Digtheid (A = dikte × wydte)*

1.4 *Spoedverhouding* = $\frac{\text{Diameter van gedrewe katrol}}{\text{Diameter van dryfkatrol}}$

1.5 *Bandlengte (plat) = [(D + d) × 1.57] + (2 × senterafstand)*

1.6 *Oopband lengte* = $\frac{\pi(D+d)}{2}+\frac{(D+d)^2}{4c}+2c$

1.7 *Gekruiste bandlengte* = $\frac{\pi(D+d)}{2}+\frac{(D+d)^2}{4c}+2c$

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

Waar:

T1 = krag in die stywe kant
T2 = krag in die slap kant
T1 – T2 = effektiewe trekkrag (Te)

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

1.10 *Wydte* = $\frac{T1}{\text{Toelaatbare trekkrag}}$

1.11 *NDR × DDR = NGD × DGD*

1.12 *Wringkrag = Krag × Radius*

1.13 *Droëvlerk (P)* = $\frac{2\pi NT}{60}$

2. STRESS AND STRAIN

2.1 $A_{shaft} = \frac{\pi d^2}{4}$

2.2 $A_{pipe} = \frac{\pi \left(D^2 - d^2\right)}{4}$

2.3 $Safety\ factor = \frac{Maximum\ stress/Break\ stress}{Safe\ working\ stress}$

2.4 $Stress = \frac{Force}{Area}$ OR $\sigma = \frac{F}{A}$

2.5 $Strain = \frac{Change\ in\ length}{Original\ length}$ OR $\varepsilon = \frac{\Delta L}{oL}$

2.6 $Young's\ modulus = \frac{Stress}{Strain}$ OR $E = \frac{\sigma}{\varepsilon}$

3. HYDRAULICS

3.1 $Pressure = \frac{Force}{Area}$ OR $P = \frac{F}{A}$

3.2 *Volume = Area × Stroke length (l or s)*

3.3 *Work done = Force × distance*

3.4 $P_A = P_B$

3.5 $\frac{F_A}{A_A} = \frac{F_B}{A_B}$

2. SPANNING EN VORMVERANDERING

2.1 $A_{as} = \frac{\pi d^2}{4}$

2.2 $A_{pyp} = \frac{\pi\left(D^2 - d^2\right)}{4}$

2.3 *Veiligheidsfaktor =* $\frac{\text{Maksimum spanning/Breekspanning}}{\text{Veilige werkspanning}}$

2.4 *Spanning =* $\frac{Krag}{Area}$ *OF* $\sigma = \frac{F}{A}$

2.5 *Vervorming =* $\frac{\text{Verandering in hoogte}}{\text{Oorspronklike lengte}}$ *OF* $\varepsilon = \frac{\Delta L}{oL}$

2.6 *Jong se modulus =* $\frac{\text{Spanning}}{\text{Vervorming}}$ *OF* $E = \frac{\sigma}{\varepsilon}$

3. HIDROULIKA

3.1 $Druk = \frac{Krag}{Area}$ *OF* $P = \frac{F}{A}$

3.2 *Volume = Oppervlakte × Slaglengte (l van s)*

3.3 *Arbeid verrig = Krag × Afstand*

3.4 *PA = PB*

3.5 $\frac{F_A}{A_A} = \frac{F_B}{A_B}$

4. RATAANDRYWING

4.1 *Droëvlerk (P) =* $\frac{2\pi NT}{60}$

4.2 *Rotverhouding =* $\frac{\text{Produk van tande op gedrewe ratte OF Snelheidsverhouding}}{\text{Produk van tande op dryfratte}}$ *verhouding =* $\frac{N_{inset}}{N_{uitset}}$

4. GEAR DRIVES

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

4.2 Gear Ratio = $\frac{Product\ of\ teeth\ on\ driven\ gear}{Product\ of\ teeth\ on\ driver\ gear}$ OR $Speed\ ratio = \frac{N_{input}}{N_{output}}$

4.3 $\frac{N_{input}}{N_{output}} = \frac{Product\ of\ teeth\ on\ driven\ gear}{Product\ of\ teeth\ on\ driver\ gear}$

4.4 $N_A \times T_A = N_B \times T_B$

4.5 Torque = Force × Radius

4.6 Torque transmitted = Gear ratio × Input torque

4.7 Module = $\frac{Pitch\text{-}circle\ diameter}{Number\ of\ teeth}$ OR $m = \frac{PCD}{T}$

4.8 $Pitch\text{-}circle\ diameter = \frac{Circular\ pitch \times Number\ of\ teeth}{\pi}$

OR

$PCD = \frac{CP \times T}{\pi}$

4.9 Outside diameter (OD) = PCD + 2(m)

4.10 Addendum = Module OR $a = m$

4.11 Dedendum (b) = 1,157 × m OR Dedendum (b) = 1,25 × m

4.12 Cutting depth (h) = 2,157 × m OR Cutting depth (h) = 2,25 × m

4.13 Clearance (c) = 0,157 × m OR Clearance (c) = 0,25 × m

4.14 Circular pitch (CP) = m × π

4.15 Working depth (WD) = 2 × m OR Working depth (WD) = 2 × a

4.3 $\frac{N_{inset}}{N_{uitset}} = \frac{\text{Produk van tande op gedrewe ratte}}{\text{Produk van tande op dryfratte}}$

4.4 $NA \times TA = NB \times TB$

4.5 Wringkrag = Krag × Radius

4.6 Wringkrag oorgedra = Ratverhouding × Insetwringkrag

4.7 $\text{Module} = \frac{\text{Steeksirkeldiameter sirkel deursnee}}{\text{Aantal tand}}$ OF $m = \frac{SSD}{T}$

4.8 $\text{Steeksirkeldiameter} = \frac{\text{Sirkelsteek} \times \text{Aantal tande}}{P}$

OF

$SSD = \frac{SS \times T}{\pi}$

4.9 Buitediameter (BD) = SSD + 2(m)

4.10 Bylae = Module OF a = m

4.11 Dedendum (b) = 1 157 × m OF Dedendum (b) = 1,25 × m

4.12 Snydiepte (h) = 2 157 × m OF Snydiepte (h) = 2,25 × m

4.13 Spasie (c) = 0,157 × m OF Vryespasie (c) = 0,25 × m

4.14 Sirkelsteek (SS) = m × π

4.15 Werkdiepte (WD) = 2 × m OF Werkdiepte (WD) = 2 × 'n

5. KEYWAYS

5.1 *Width (W)* = $\frac{D}{4}$

5.2 *Thickness (T)* = $\frac{D}{6}$

5.3 *Length (L) = 1,5 × D*
Where:
D = Diameter of shaft

5.4 *Standard taper for taper key: 1 in 100 or 1 : 100*

6. CINCINNATI DIVIDING HEAD TABLE FOR 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*
Change gears											
Gears	*24 x 2*	*28*	*32*	*40*	*44*	*48*	*56*	*64*	*72*	*86*	*100*

6.1 *Indexing* = $\frac{40}{n}$ *(n = number of divisions)*

6.2 $\frac{Dr}{Dn} = \frac{A-n}{A} \times \frac{40}{1}$ *OR* $\frac{Dr}{Dn} = (A-n) \times \frac{40}{A}$

Where:
A = chosen number of divisions
n = real number of divisions

7. DOVETAILS

Where:

R = *Radius of precision roller*
y = *Distance from top edge of dovetail in relation to bottom corner of dovetail*
x = *Distance from middle of precision roller to bottom corner of dovetail*
θ = *Dovetail included angle (normally 60°)*
h = *Height of dovetail*
w = *Minimum width of dovetail*
W = *Maximum width of dovetail*
m = *Distance between rollers*
M = *Distance over rollers*

5. SPYGLEUWE

5.1 *Wydte (W)* = $\frac{D}{4}$

5.2 *Dikte (T)*= $\frac{D}{6}$

5.3 *Lengte (L) = 1,5 × D*

Waar:

D = Deursnee van as

5.4 *Standaardtaps vir tapse spy: 1 in 100 of 1 : 100*

6. CINCINNATI-VERDEELKOPTABEL VIR FREESMASJIEN

Gatsirkels											
Kant 1	*24*	*25*	*28*	*30*	*34*	*37*	*38*	*39*	*41*	*42*	*43*
Kant 2	*46*	*47*	*49*	*51*	*53*	*54*	*57*	*58*	*59*	*62*	*66*
Wisselratte											
Ratte	*24 × 2*	*28*	*32*	*40*	*44*	*48*	*56*	*64*	*72*	*86*	*100*

6.1 *Indeksering* = $\frac{40}{n}$ *(n = aantal indelings)*

6.2 $\frac{Dr}{Gd} = \frac{A-n}{A} \times \frac{40}{1}$ *OF* $\frac{Dr}{Gd} = (A-n) \times \frac{40}{A}$

Waar:

A = gekose aantal indelings

n = werklike aantal indelings

7. SWAELSTERTE

Waar:

R = Radius van presisieroller

y = Afstand vanaf die hoogste rand van die swaelstert in verhouding tot die onderste hoek van swaelstert

x = Afstand vanaf die middel van presisieroller na die onderste hoek van die swaelstert

θ = Ingeslote hoek van swaelstert (gewoonlik 60°)

h = Hoogte van swaelstert

w = Minimum wydte van swaelstert

W = Maksimum wydte van swaelstert

m = Afstand tussen rollers

M = Afstand oor rollers

8. TAPERS

8.1 $\tan\frac{\theta}{2} = \frac{D - d}{2 \times l}$ *(l = Taper length)*

8.2 $Tail\ stock\ set\text{-}over = \frac{L(D - d)}{2 \times l}$ *(L = Distance between centres)*

9. SCREW THREADS

9.1 *Mean diameter = Outside diameter – (½ × Pitch)* OR $D_m = OD - \frac{P}{2}$

9.2 *Effective diameter (D_{eff}) = Pitch diameter (D_p) = Mean diameter (D_m)*

9.3 *Lead = Pitch × Number of starts*

9.4 *Height of screw thread = 0,866 × Pitch (P)*

9.5 *Depth of screw thread = 0,613 × Pitch (P)*

9.6 *Helix angle: Tan θ =* $\frac{Lead}{\pi \times D_m}$

9.7 *Leading angle = 90° – (Helix angle + Clearance angle)*

9.8 *Following angle = 90° + (Helix angle – Clearance angle)*

9.9 $D_P = D_N - (0{,}866 \times P)$

8. TAPSE

8.1 $\tan \frac{\theta}{2} = \frac{D - d}{2 \times l}$ *(l = tapselengte)*

8.2 $Loskopoors\ telling = \frac{L(D - d)}{2 \times l}$ *(L = Afstand tussen senters)*

9. SKROEFDRADE

9.1 *Gemiddelde deursnee = Buitenste deursnee - (1/2 × toonhoogte) OF* $D_m = BD - \frac{P}{2}$

9.2 *Effektiewe Diameter (Deff) = Steekdiameter (Dp) = Gemiddelde diameter (Dm)*

9.3 *Styging = Steek × Aantal beginne*

9.4 *Hoogte van draad = 0,866 × toonhoogte (P)*

9.5 *Diepte van skroefdraad = 0,613 × Steek (P)*

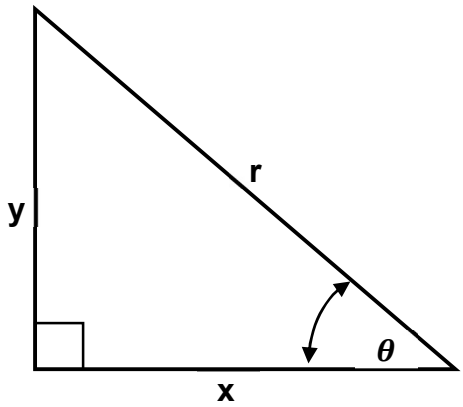
9.6 *Helixhoek: Tan θ =* $\frac{Styging}{\pi \times D_m}$

9.7 *Ingryphoek/Voorsnyhoek = 90° – (Helikshoek + Vryloophoek)*

9.8 *Sleephoek/Nasnyhoek = 90° + (Helikshoek – Vryloophoek)*

9.9 *DP = DN – (0,866 × P)*

10. PYTHAGORAS' THEOREM AND TRIGONOMETRY



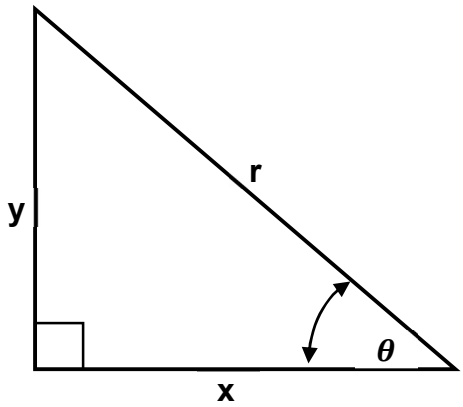
10.1 $Sin\ \theta = \frac{y}{r}$

10.2 $Cos\ \theta = \frac{x}{r}$

10.3 $Tan\ \theta = \frac{y}{x}$

10.4 $r^2 = x^2 + y^2$

10. PYTHAGORAS SE STELLING EN TRIGONOMETRIE



10.1 $Sin\ \theta = \frac{y}{r}$

10.2 $Cos\ \theta = \frac{x}{r}$

10.3 $Tan\ \theta = \frac{y}{x}$

10.4 $r^2 = x^2 + y^2$