



# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NASIONALE  
SENIOR SERTIFIKAAT**

**GRAAD 12**

**MCHT.1  
MEGANIESE TEGNOLOGIE  
NOVEMBER 2016**

**PUNTE: 200**

**TYD: 3 uur**

**Hierdie vraestel bestaan uit 16 bladsye en 'n 4 bladsy-formuleblad.**

# **MIDDAGSESSIE**



**INSTRUKSIES EN INLIGTING**

1. Hierdie vraestel bestaan uit TIEN vrae.
2. Skryf jou sentrumnommer en eksamennummer in die ruimtes wat daarvoor op die ANTWOORDEBOEK verskaf is.
3. Lees AL die vrae aandagtig deur.
4. Beantwoord AL die vrae.
5. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.
6. Begin ELKE vraag op 'n NUWE bladsy.
7. Toon ALLE berekeninge en eenhede. Rond ALLE antwoorde tot TWEE desimale plekke af.
8. Kandidate mag nieprogrammeerbare, wetenskaplike sakrekenaars en tekeninstrumente gebruik.
9. Neem die waarde van gravitasiekrag as  $10 \text{ m/s}^{-2}$ .
10. Alle afmetings is in millimeter, tensy anders in die vraag aangedui.
11. 'n Formuleblad vir jou gebruik is by hierdie vraestel aangeheg.
12. Skryf netjies en leesbaar.
13. Gebruik die riglyne hieronder om jou te help om jou tyd te bestuur.

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



**VRAAG 1: MEERVOUDIGEKEUSE-VRAE**

Verskeie opsies word as moontlike antwoorde op die volgende vrae gegee. Skryf die vraagnommer (1.1–1.20) neer, kies die antwoord en maak 'n kruisie (X) oor die letter (A–D) van jou keuse in die ANTWOORDEBOEK.

VOORBEELD:

1.21  A  B  C  D

1.1 Aan watter veiligheidsmaatreël moet daar ten opsigte van die freesmasjien voldoen word, volgens die Wet op Beroepsgesondheid en Veiligheid, 1993 (Wet 85 van 1993)?

- A Moenie 'n moersleutel op roterende werk gebruik nie.
- B Verwyder skerms terwyl materiaal gesny word.
- C Maak seker die wiel is bygewerk.
- D Gebruik die masjientafel as 'n aambeeld. (1)

1.2 Watter veiligheidsmaatreël is van toepassing op die hidrouliese pers volgens die Wet op Beroepsgesondheid en Veiligheid?

- A Moenie die veilige druklimiet oorskry nie.
- B Werk teen 'n veilige spoed.
- C Smeer die werkstuk voor dit op die pers gemonteer word.
- D Gebruik die maksimum druk vir dikker materiaal. (1)

1.3 'n Brinell-toetsers word gebruik om 'n materiaal se ... te toets.

- A trekspanning
- B elastisiteit
- C hardheid
- D brosheid (1)

1.4 Watter EEN van die volgende stellings beskryf die funksie van die trektoetsers?

- A Bepaal die lengte van die materiaal
- B Verander die lengte van die materiaal
- C Bepaal die treksterkte van die materiaal
- D Bepaal die trekverhouding van die materiaal (1)

1.5 'n Ferrietstruktuur is ...

- A sterk en bros.
- B sag en rekbaar.
- C hard en bros.
- D sag en bros. (1)

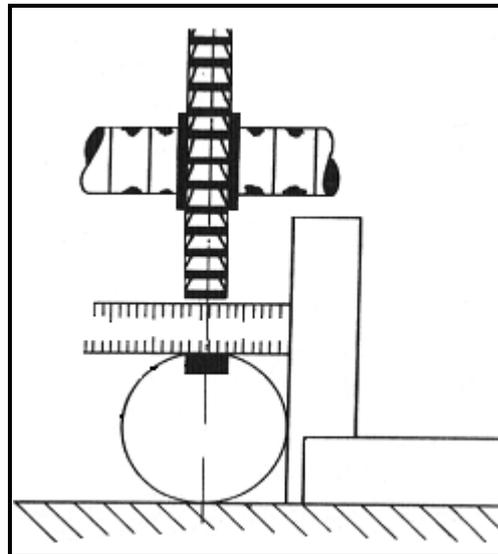


1.6 Die laer kritieke temperatuur vir koolstaal is ...

- A 100 °C.
- B 950 °C.
- C 720 °C.
- D 610 °C.

(1)

1.7 Watter freesprosedure word in FIGUUR 1.1 getoon?



**FIGUUR 1.1**

- A Opfreeswerk
- B Ratsnywerk
- C Klimfreeswerk
- D Sentrering van 'n freessnyer

(1)

1.8 Wat is die ingeslote hoek van 'n metrieke V-skroefdraad?

- A 30°
- B 29°
- C 60°
- D 55°

(1)

1.9 Watter EEN van die volgende is 'n algemene oorsaak van poreusheid in 'n sweislas?

- A Vuil of nat elektrodes wat tydens boogswearing gebruik word
- B Slak wat nie van die eerste sweisoppervlak verwyder word voor 'n tweede sweislopie nie
- C Foutiewe heraansit deur nie weer aan die bokant van die vorige sweislopie te begin nie
- D 'n Sweisstroom wat te laag is

(1)

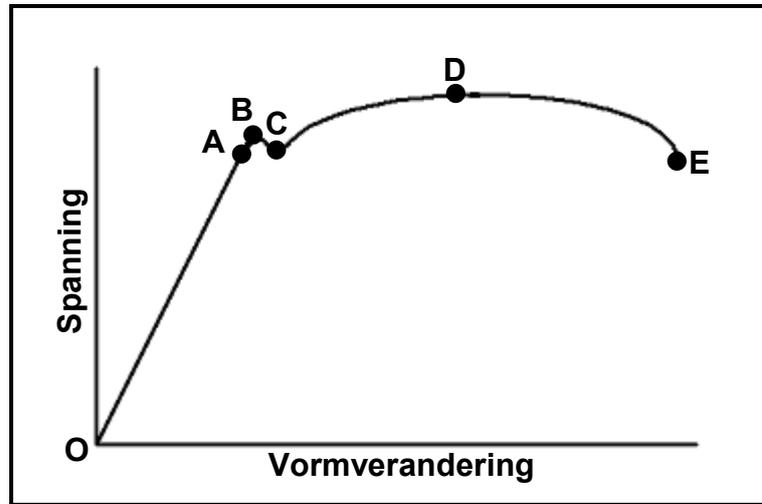
1.10 Wat is die definisie van slakinsluiting as 'n sweisdefek?

- A Metaalagtige vaste stowwe wat in die sweismetaal vasgevang is
- B Gasporieë wat in die gestolde sweiskraal voorkom
- C Nie-metaalagtige vaste stowwe wat in die sweismetaal vasgevang is
- D Gesmelte oppervlakonsuiwerhede wat in die sweisoppervlak vasgevang is

(1)



1.11 Wat word deur reguitlyn OA in die spanning-vormverandering-grafiek in FIGUUR 1.2 voorgestel?

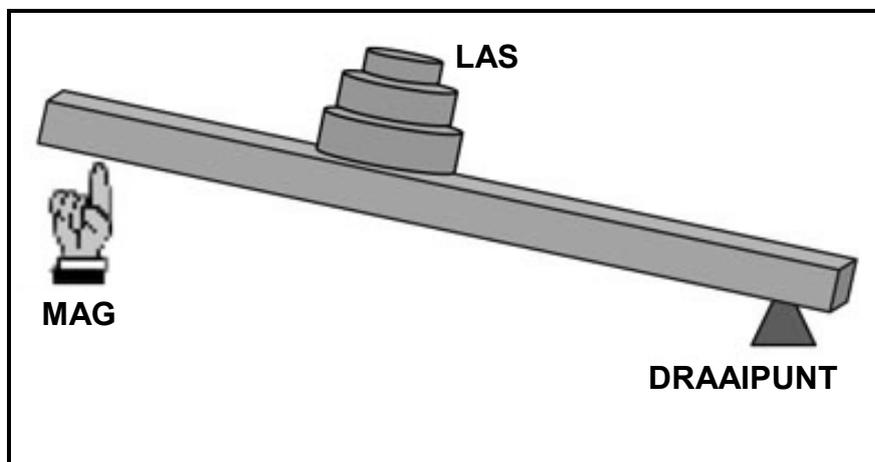


FIGUUR 1.2

- A Die verskil tussen die spanning en vormverandering
- B Die indirekte eweredigheid tussen die spanning en vormverandering
- C Die eweredigheid tussen die spanning en vormverandering
- D Die ooreenkoms tussen die spanning en vormverandering

(1)

1.12 Wat is die klas van die hefboom wat in FIGUUR 1.3 getoon word?



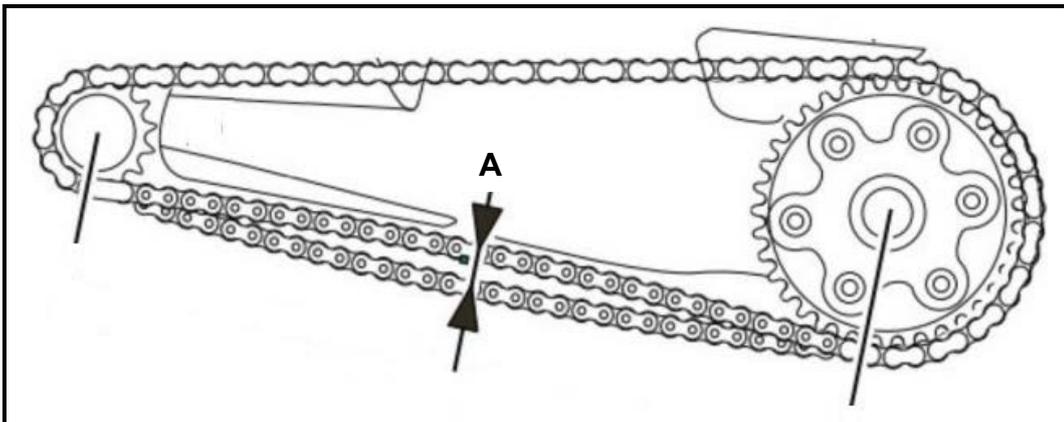
FIGUUR 1.3

- A 1<sup>ste</sup> klas
- B 2<sup>de</sup> klas
- C 3<sup>de</sup> klas
- D 4<sup>de</sup> klas

(1)

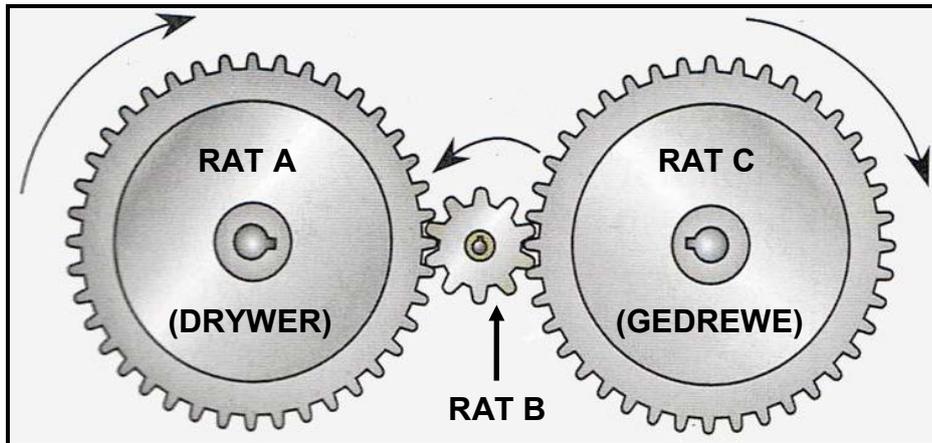


- 1.13 Die wet van momente word gedefinieer as 'n stelsel van kragte wat in ewewig is indien die ...
- A koëffisiënt van die kloksgewyse momente om 'n punt gelyk is aan die koëffisiënt van die antikloksgewyse momente om dieselfde punt.
  - B verskil van die kloksgewyse momente om 'n punt gelyk is aan die verskil van die antikloksgewyse momente om dieselfde punt.
  - C som van die kloksgewyse momente om 'n punt gelyk is aan die som van die antikloksgewyse momente om dieselfde punt.
  - D produk van die kloksgewyse momente om 'n punt gelyk is aan die produk van die antikloksgewyse momente om dieselfde punt. (1)
- 1.14 Watter EEN van die volgende is 'n voordeel van 'n kettingaandrywingstelsel?
- A Lae koste
  - B Geen smering nodig nie
  - C Gladde werking
  - D Glipvrye aandrywing (1)
- 1.15 Watter stap om die spanning in 'n ketting van 'n kettingaandrywing te verstel, word by punt **A** in FIGUUR 1.4 getoon?

**FIGUUR 1.4**

- A Kontroleer die afstand tussen die middelpunte (senters).
- B Maak die klampbout los en skroef die verstelbout in of uit.
- C Kontroleer die hoeveelheid speling in die ketting.
- D Draai die klampbout stywer vas. (1)

1.16 FIGUUR 1.5 toon 'n ratstel met drie ratte wat inkam. Wat word rat **B** genoem?

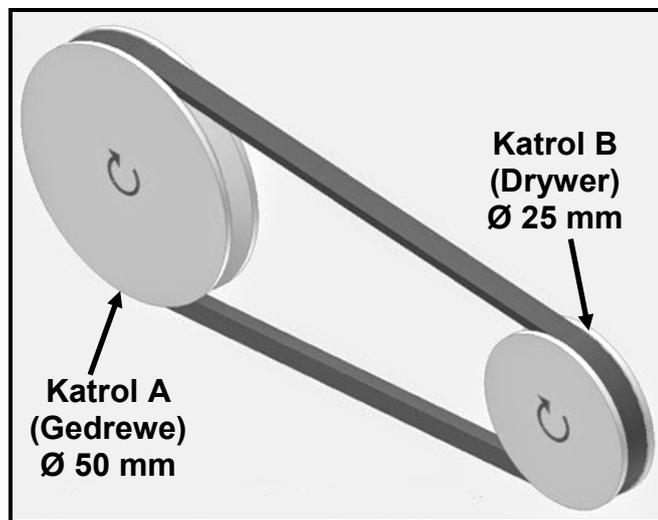


FIGUUR 1.5

- A Heliese rat
- B Tandstang
- C Tussenrat
- D Kleinrat

(1)

1.17 Wat sal katrol **A** se rotasiefrekwensie wees indien katrol **B** teen 1 000 r/min roteer, soos in FIGUUR 1.6 getoon?



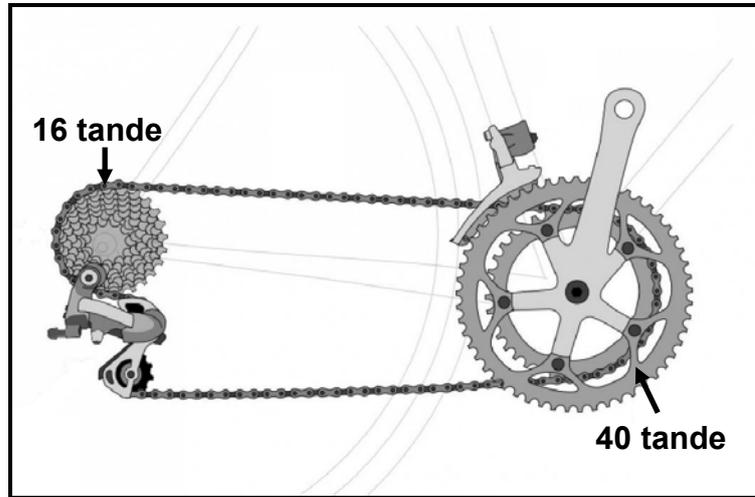
FIGUUR 1.6

- A 1 000 r/min
- B 2 000 r/min
- C 500 r/min
- D 100 r/min

(1)



1.18 Bepaal die spoedverhouding van die kettingaandrywing van die resiesfiets wat in FIGUUR 1.7 getoon word.



FIGUUR 1.7

- A 40 : 1
- B 1 : 40
- C 2,5 : 1
- D 1 : 2,5

(1)

1.19 Wat is die funksie van die morssluis ('waste gate') in 'n turbo-aanjaer? Dit stel oormatige ... vry.

- A druk
- B vog
- C hitte
- D olie

(1)

1.20 'n Stoomturbine word gebruik om ...

- A die brandstofverbruik in verhouding met die enjinlewering te verhoog.
- B die volumetriese rendement van 'n vierslag-dieselenjin te verhoog.
- C 'n generator aan te dryf om elektrisiteit op te wek.
- D die atmosferiese druk van 'n enjin te verlaag.

(1)

[20]



**VRAAG 2: VEILIGHEID**

- 2.1 Alle persoonlike en omgewingsveiligheidsreëls is gevolg toe 'n operateur 'n vlakslyper gebruik het. Noem TWEE veiligheidsmaatreëls wat gevolg moet word terwyl die vlakslyper in werking is. (2)
- 2.2 Gee TWEE voorbeelde van persoonlike veiligheidstoerusting wat tydens boogswearing gebruik moet word. (2)
- 2.3 Noem TWEE veiligheidsmaatreëls wat in ag geneem moet word voordat krag op 'n laertrekker toegepas word. (2)
- 2.4 Wat is die maksimum veilige afstand tussen die slypwiel en die beitelslee op 'n bankslypmasjien? (1)
- 2.5 Noem DRIE veiligheidsmaatreëls wat nagekom moet word wanneer 'n Rockwell-hardheidstoets gebruik word. (3)
- [10]**

**VRAAG 3: GEREEDSKAP EN TOERUSTING**

- 3.1 Gee TWEE redes waarom 'n buigtoets op 'n dakbalk uitgevoer word. (2)
- 3.2 Gee TWEE redes vir 'n hoë CO-lesing wanneer 'n gasanalistoets op 'n motorvoertuig se enjin uitgevoer word. (2)
- 3.3 Noem TWEE voordele van die MIG/MAGS-sweisproses. (2)
- 3.4 Noem TWEE toetse wat met 'n multimeter gedoen kan word. (2)
- 3.5 As gevolg van enjinkragverlies in 'n voertuig voer die werktuigkundige 'n kompressietoets volgens sekere prosedures uit. Waarom word die prosedures hieronder gevolg?
- 3.5.1 Verwyder die hoogspanningsdraad. (1)
- 3.5.2 Ontkoppel die brandstofinspuitingstelsel. (1)
- 3.5.3 Maak die versnellerklep heeltemal oop. (1)
- 3.5.4 Teken die lesings aan. (1)
- [12]**

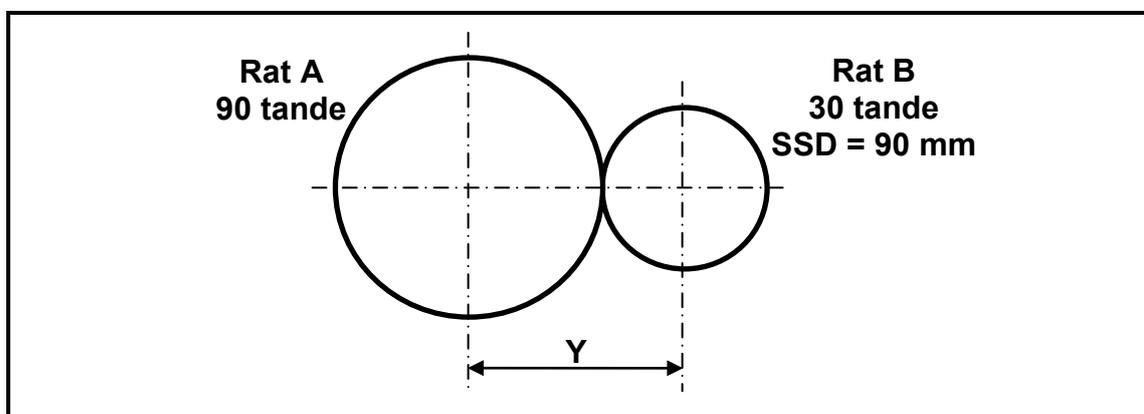


**VRAAG 4: MATERIAAL**

- 4.1 Noem TWEE eienskappe van die sementietstruktuur van koolstaal. (2)
- 4.2 Wat is die doel van dopverharding op 'n nokas? (2)
- 4.3 Wat is die doel van die tempering van verharde staal? (2)
- 4.4 Toon, met behulp van 'n netjiese tekening, die volgende elemente op 'n yster-koolstof-ewewigdiagram:
- 4.4.1 Koolstofinhoud van 0% tot 1,4% (1)
- 4.4.2 Temperatuur van 0 °C tot 1 000 °C (1)
- 4.4.3 AC<sub>1</sub>-lyn (1)
- 4.4.4 AC<sub>3</sub>-lyn (1)
- 4.4.5 Oustenietstruktuur (1)
- 4.4.6 Ferrietstruktuur (1)
- 4.4.7 Perlietstruktuur (1)

**[13]****VRAAG 5: TERMINOLOGIE**

- 5.1 FIGUUR 5.1 toon twee reguittandratte wat inkam.

**FIGUUR 5.1**

Gebruik die inligting hierbo en bereken die:

- 5.1.1 Module van die klein rat (2)
- 5.1.2 Buitediameter van die groot rat (2)
- 5.1.3 SSD van die groot rat (2)
- 5.1.4 Dedendum van die groot rat (2)
- 5.1.5 Sentrafstand tussen die twee ratte (afstand Y) (3)
- 5.1.6 Verlangde indeksering vir 'n rat met 33 tande (3)

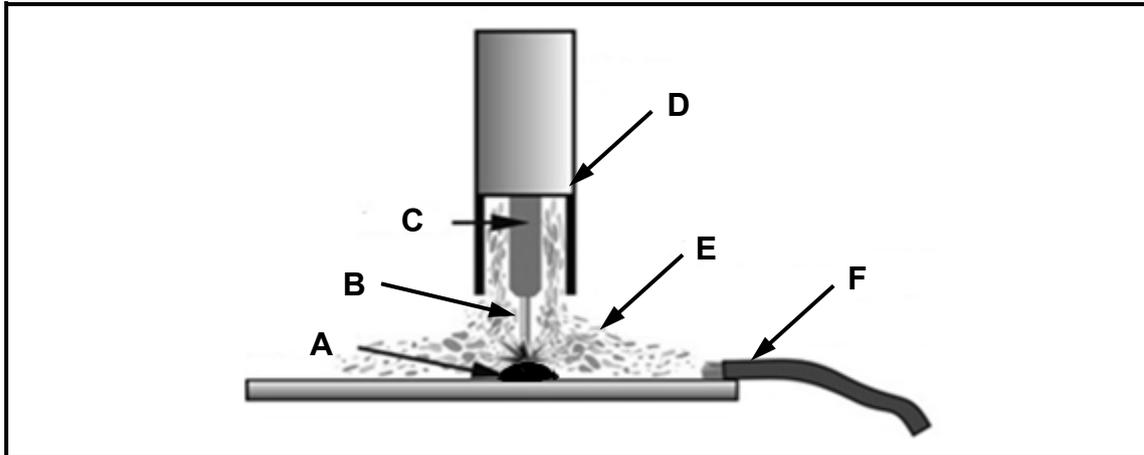
- 5.2 'n Tapse spy moet gemaak word om op 'n as van 92 mm diameter te pas. Bereken die volgende:
- 5.2.1 Die wydte/breedte van die spy (2)
  - 5.2.2 Die lengte van die spy (2)
  - 5.2.3 Die dikte van die spy by die groter punt (2)
  - 5.2.4 Die dikte van die spy by die kleiner punt (4)
- 5.3 Verduidelik die funksies van die volgende komponente op die verdeelkop wat op 'n freesmasjien gebruik word:
- 5.3.1 Indeksplaat (2)
  - 5.3.2 Sektorarms (2)
- 5.4 Noem TWEE metodes wat op 'n senterdraaibank gebruik kan word om eksterne V-skroefdrade met 'n eenpunt-skroefdraadsnybeitel te sny. (2)
- [30]**

#### **VRAAG 6: HEGTINGSMETODES**

- 6.1 Noem TWEE oorsake van ELK van die volgende sweisdefekte:
- 6.1.1 Insnyding (2)
  - 6.1.2 Samesmeltingsgebrek (2)
- 6.2 Verduidelik hoe die ultrasoniese toets op 'n sweislas uitgevoer word. (6)
- 6.3 Noem EEN voordeel van die uitvoer van 'n ultrasoniese toets eerder as 'n X-straaltoets op 'n sweislas. (1)
- 6.4 'n X-straaltoets word op 'n sweislas uitgevoer. Hoe word die resultate waargeneem en aangeteken? (2)
- 6.5 Verduidelik die doel van die kleurstofdeurdringingstoets op 'n sweislas. (2)
- 6.6 Gee TWEE voorbeelde van beskadigde (destruktiwe) toetse wat op sweislasse uitgevoer word. (2)
- 6.7 Noem TWEE gasse wat met MIG/MAGS-sweising gebruik word. (2)



6.8 FIGUUR 6.1 toon die MIG/MAGS-sweisproses. Benoem A–F.

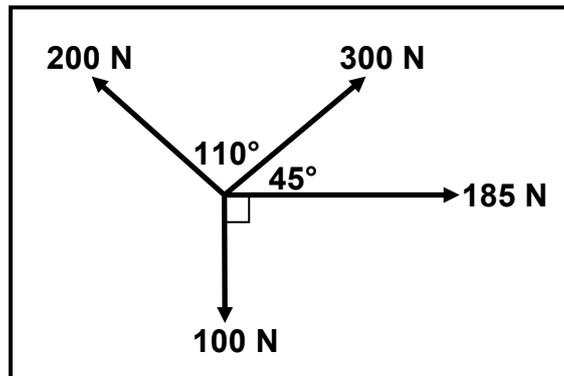


FIGUUR 6.1

(6)  
[25]

**VRAAG 7: KRAGTE**

7.1 Vier trekkragte van 100 N, 200 N, 300 N en 185 N trek vanaf dieselfde aangrypingspunt, soos in FIGUUR 7.1 getoon. Bepaal, deur middel van berekeninge, die grootte en rigting van die resultant van die stelsel van kragte in FIGUUR 7.1.



FIGUUR 7.1

(13)

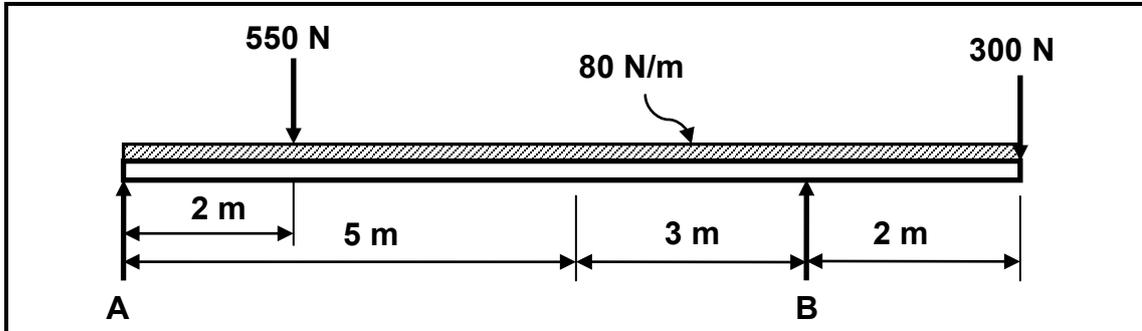
7.2 'n Las van 40 kN veroorsaak 'n trekspanning van 20 MPa in 'n ronde geelkoperstaaf. Die oorspronklike lengte van die staaf is 300 mm. Young se modulus vir geelkoper is 90 GPa.

Bereken die:

- 7.2.1 Diameter van die staaf (5)
- 7.2.2 Vormverandering (3)
- 7.2.3 Verandering in lengte (3)



- 7.3 FIGUUR 7.2 toon 'n eenvormige balk wat deur twee vertikale stutte, **A** en **B**, ondersteun word. 'n Eenvormig verspreide krag van  $80 \text{ N/m}$  word oor die hele lengte van die balk uitgeoefen. Bepaal, deur middel van berekeninge, die groottes van die reaksies in stut **A** en **B**.



FIGUUR 7.2

(6)  
[30]**VRAAG 8: INSTANDHOUDING**

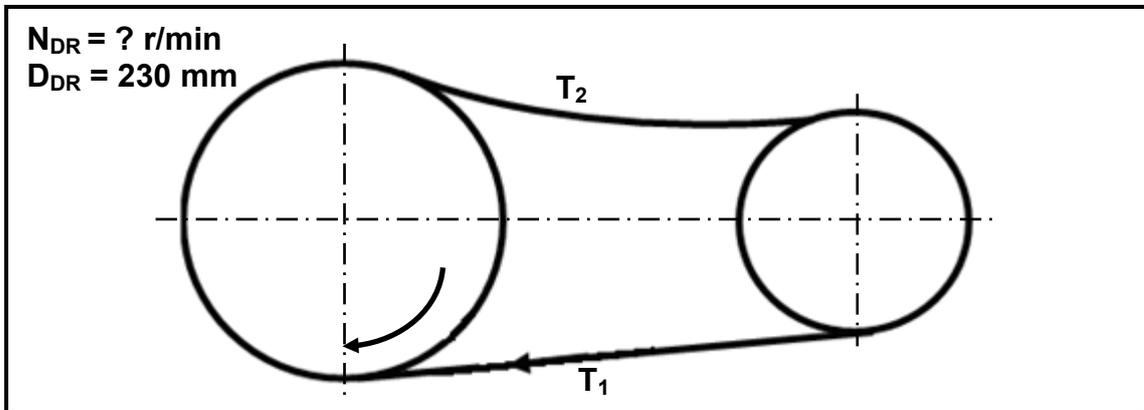
- 8.1 Noem DRIE gevolge van 'n gebrek aan roetine-instandhouding. (3)
- 8.2 Noem TWEE subgroepe van voorkomende instandhouding. (2)
- 8.3 Definieer die volgende eienskappe van olies:
- 8.3.1 Vloeipunt (2)
- 8.3.2 Flitspunt (2)
- 8.4 Waarom word bande op bandaandrywings gereeld verstel of vervang? (2)
- 8.5 Waarom word snyvloestof op die snybeitel gebruik gedurende die masjineringsprosesse op 'n senterdraaibank? (2)
- 8.6 Hoe word kettingaandrywings in stand gehou? (2)

[15]



**VRAAG 9: STELSLS EN BEHEER**

9.1 FIGUUR 9.1 toon 'n bandaandrywingstelsel met 'n 230 mm-dryfkatrol. Die bandspoed in hierdie stelsel is  $36 \text{ m}\cdot\text{s}^{-1}$ . Die trekrag in die slap kant is 140 N en die verhouding tussen die krag in die stywe kant en die krag in die slap kant is 2,5.



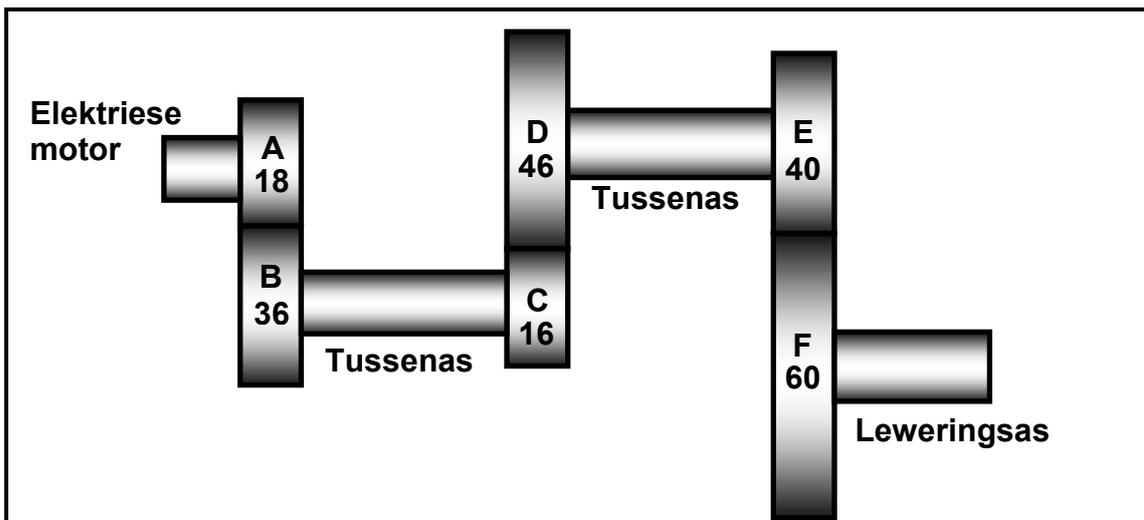
**FIGUUR 9.1**

Bereken die:

9.1.1 Rotasiefrekwensie van die dryfkatrol in r/min (4)

9.1.2 Drywing wat in hierdie stelsel oorgedra word (4)

9.2 FIGUUR 9.2 toon 'n rataandrywingstelsel. Dryfrat **A** op die as van die elektriese motor het 18 tande wat met rat **B** met 36 tande op 'n tussenas inkam. Daar is 'n tweede dryfrat, **C**, op die tussenas met 16 tande wat met rat **D** met 46 tande op 'n tweede tussenas inkam. Die tweede tussenas het 'n derde dryfrat, **E**, met 40 tande wat rat **F** met 60 tande op die leweringsas aandryf.



**FIGUUR 9.2**

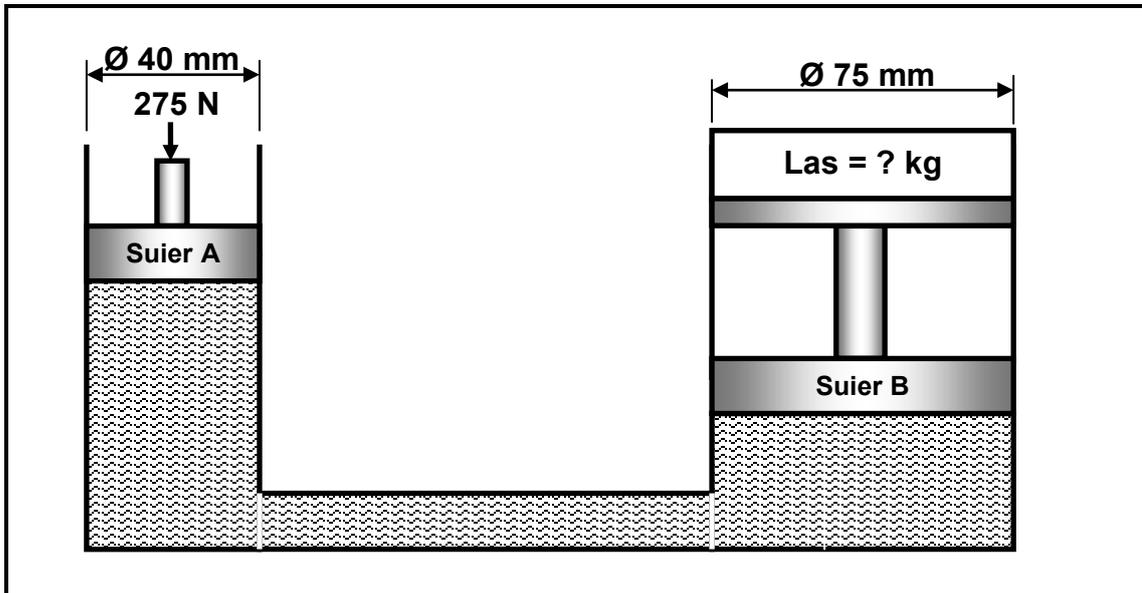
Bereken die:

9.2.1 Rotasiefrekwensie van die inset-as op die elektriese motor indien die leweringsas teen 160 r/min moet roteer (3)

9.2.2 Snelheidsverhouding tussen die inset-as en leweringsas (2)



- 9.3 'n Hidrouliese stelsel word gebruik om 'n draaibank op te hys. Die spesifikasies van die stelsel word diagrammadies in FIGUUR 9.3 voorgestel.



FIGUUR 9.3

Bereken die:

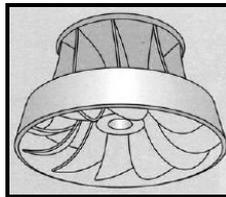
- 9.3.1 Vloeistofdruk in die hidrouliese stelsel wanneer dit in ewewig is (4)
- 9.3.2 Las in kilogram wat deur suier B gelig kan word indien 'n krag van 275 N op suier A uitgeoefen word (4)
- 9.4 Wat is die doel van traksiebeheer in 'n voertuig? (2)
- 9.5 Lugsakke in 'n voertuig word as 'n passiewe veiligheidseienskap beskryf. Verduidelik die betekenis van die term *passiewe veiligheidseienskap*. (2)
- [25]

### VRAAG 10: TURBINES

- 10.1 Noem TWEE tipes blasers wat as superaanjaers in 'n motorvoertuig se enjin gebruik word. (2)
- 10.2 Noem die hoof funksie van superaanjaers. (2)
- 10.3 Noem TWEE voordele van 'n superaanjaer wanneer dit met 'n turbo-aanjaer vergelyk word. (2)
- 10.4 Hoe word 'n turbo-aanjaer aangedryf? (1)
- 10.5 Definieer die *wegholspoed* van 'n waterturbine. (2)

10.6 Noem die werkbeginsels van ELK van die drie waterturbines wat in FIGUUR 10.1, 10.2 en 10.3 getoon word.

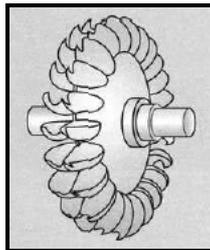
10.6.1



**FIGUUR 10.1**

(2)

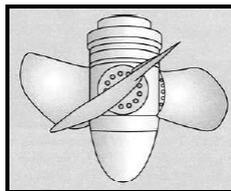
10.6.2



**FIGUUR 10.2**

(2)

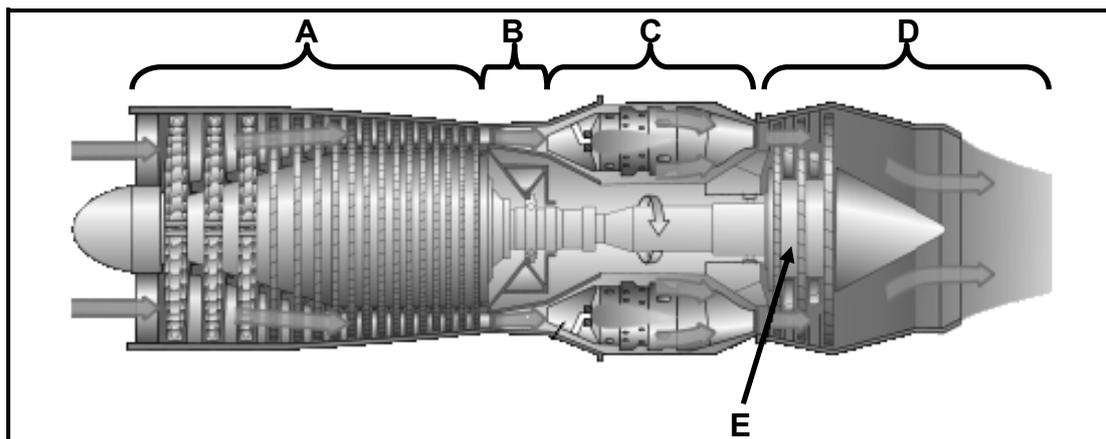
10.6.3



**FIGUUR 10.3**

(2)

10.7 'n Gasturbine wat as 'n straler-enjin ('jet engine') gebruik word, word in FIGUUR 10.4. getoon. Benoem fase **A** tot **D** en onderdeel **E**.



**FIGUUR 10.4**

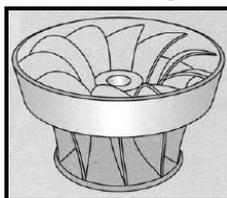
(5)  
[20]

**TOTAAL: 200**



10.6 State the operational principles of EACH of the three water turbines shown in FIGURES 10.1, 10.2 and 10.3.

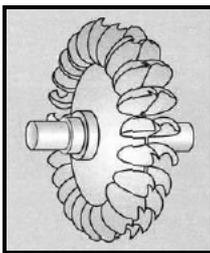
10.6.1



(2)

FIGURE 10.1

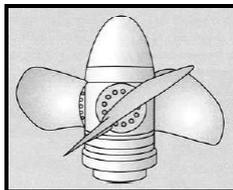
10.6.2



(2)

FIGURE 10.2

10.6.3



(2)

FIGURE 10.3

10.7

A gas turbine that is used as a jet engine is shown in FIGURE 10.4. Label phases A to D and part E.

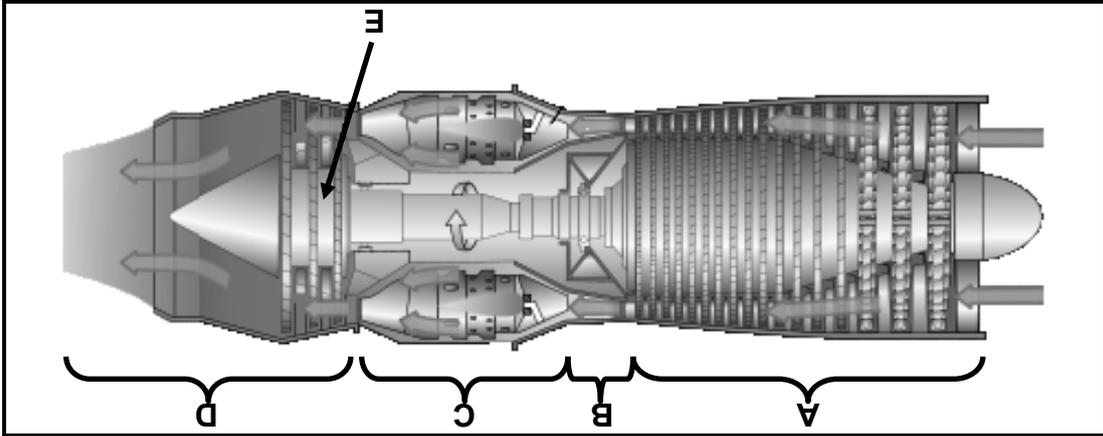


FIGURE 10.4

(5)  
[20]

TOTAL:

200



9.3 A hydraulic system is used to lift a lathe. The specifications of the system are presented diagrammatically in FIGURE 9.3.

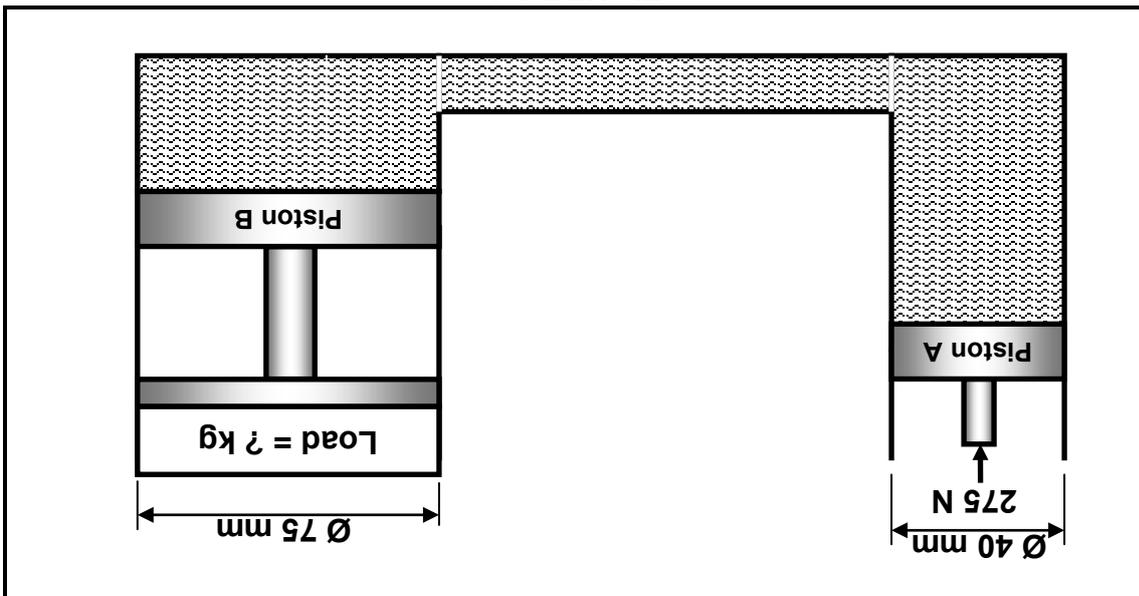


FIGURE 9.3

Calculate the:

9.3.1 Fluid pressure in the hydraulic system when in equilibrium (4)

9.3.2 Load in kilogram that can be lifted by piston B if a force of 275 N is exerted upon piston A (4)

9.4 What is the purpose of traction control in a vehicle? (2)

9.5 Airbags in a vehicle are described as a passive safety feature. Explain the meaning of the term *passive safety feature*. (2)

**QUESTION 10: TURBINES**

10.1 Name TWO types of blowers that are used as superchargers in the engine of a motor vehicle. (2)

10.2 State the main function of superchargers. (2)

10.3 State TWO advantages of a supercharger when compared to a turbocharger. (2)

10.4 How is a turbocharger driven? (1)

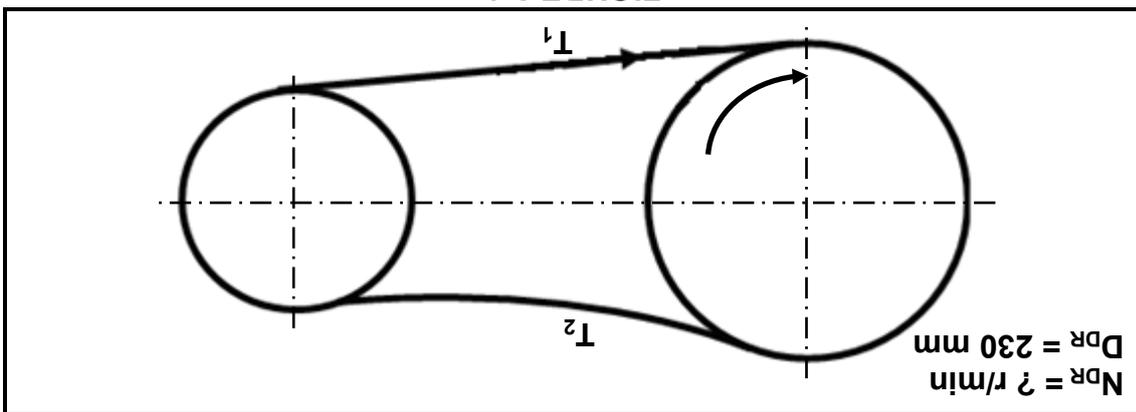
10.5 Define the *run-away speed* of a water turbine. (2)



[25]

**QUESTION 9: SYSTEMS AND CONTROL**

9.1 FIGURE 9.1 shows a belt-drive system with a 230 mm driver pulley. The belt speed in this system is 36 m.s<sup>-1</sup>. The tensile force in the slack side is 140 N and the ratio between the force in the tight side and the force in the slack side is 2,5.

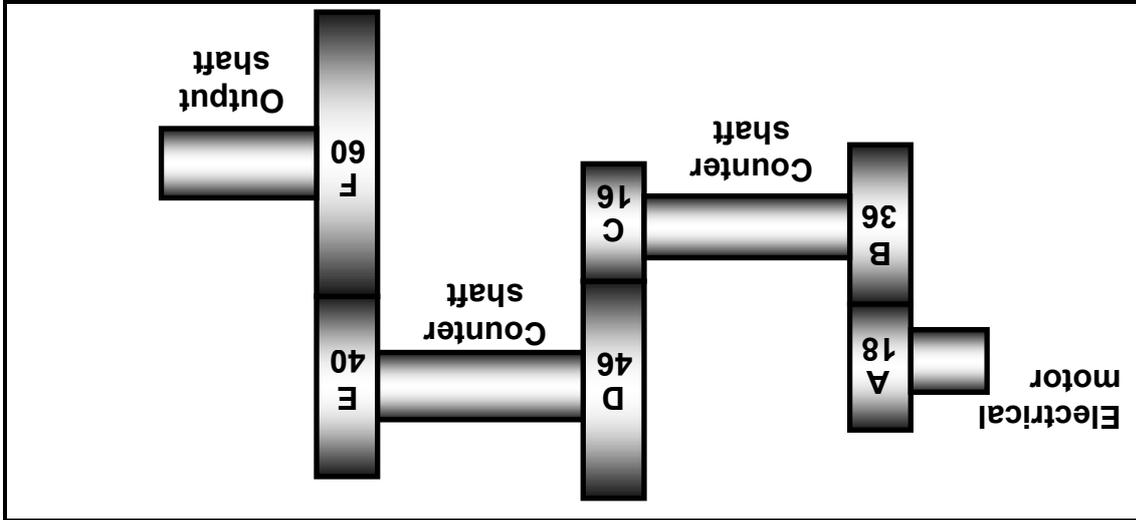


Calculate the:

- 9.1.1 Rotation frequency of the driver pulley in r/min (4)
- 9.1.2 Power transmitted in this system (4)

9.2

FIGURE 9.2 shows a gear-drive system. Driver gear A on the shaft of the electric motor has 18 teeth that mesh with gear B with 36 teeth on a counter shaft. On the counter shaft is a second driver gear, C, with 16 teeth that mesh with gear D with 46 teeth on a second counter shaft. The second counter shaft has a third driver gear, E, with 40 teeth, which drives gear F with 60 teeth on the output shaft.



**FIGURE 9.2**

Calculate the:

- 9.2.1 Rotation frequency of the input shaft on the electric motor if the output shaft needs to rotate at 160 r/min (3)
- 9.2.2 Velocity ratio between the input shaft and output shaft (2)



7.3 FIGURE 7.2 shows a uniform beam that is supported by two vertical supports, **A** and **B**. A uniformly distributed force of 80 N/m is exerted over the whole length of the beam. Determine, by means of calculations, the magnitudes of the reactions in supports **A** and **B**.

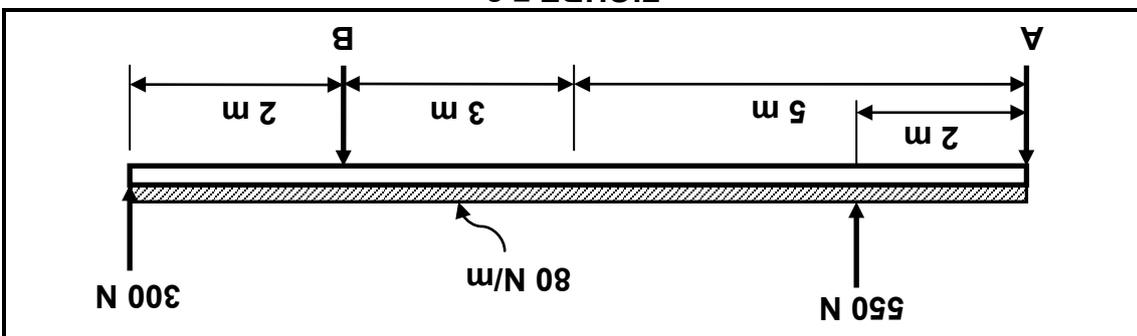


FIGURE 7.2

[30]  
(6)

**QUESTION 8: MAINTENANCE**

- 8.1 Name THREE effects of a lack of routine maintenance. (3)
- 8.2 Name TWO subgroups of preventative maintenance. (2)
- 8.3 Define the following properties of oils: (2)
- 8.3.1 Pour point (2)
- 8.3.2 Flashpoint (2)
- 8.4 Why are belts on belt drives adjusted or replaced regularly? (2)
- 8.5 Why is cutting fluid used on the cutting tool during the machining processes on a centre lathe? (2)
- 8.6 How are chain drives maintained? (2)

[15]



6.8

FIGURE 6.1 shows the MIG/MAGS welding process. Label A-F.

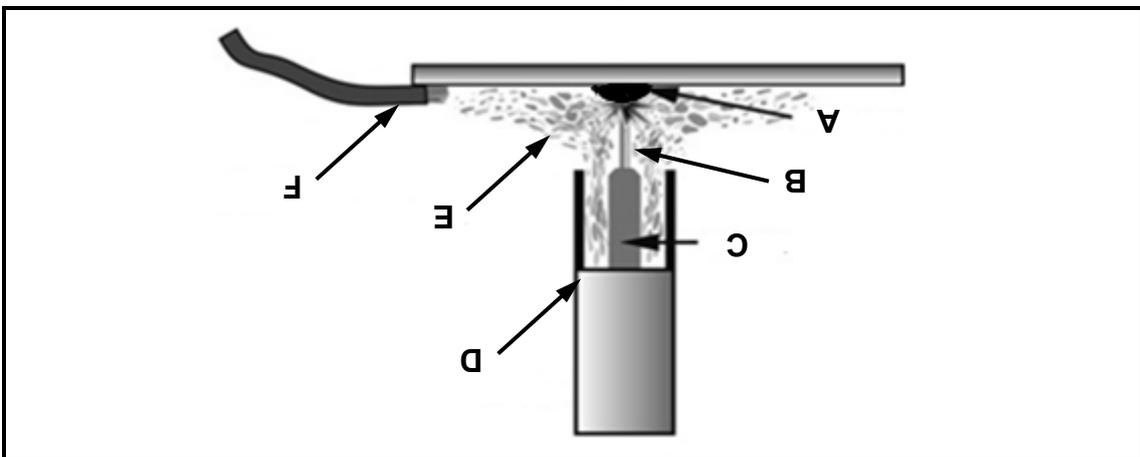


FIGURE 6.1

(6)  
[25]

**QUESTION 7: FORCES**

7.1

Four pulling forces of 100 N, 200 N, 300 N and 185 N are acting from the same acting point, as shown in FIGURE 7.1. Determine, by means of calculations, the magnitude and direction of the resultant of the system of forces in FIGURE 7.1.

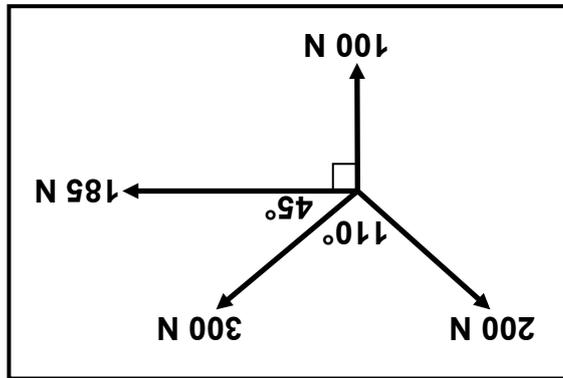


FIGURE 7.1

(13)

7.2

A load of 40 kN causes a tensile stress of 20 MPa in a round brass bar. The original length of the bar is 300 mm. Young's modulus for brass is 90 GPa.

Calculate the:

7.2.1 Diameter of the bar

7.2.2 Strain

7.2.3 Change in length

(3)

(3)

(5)



5.2 A taper key must be made to fit onto a 92 mm diameter shaft. Calculate the following:

5.2.1 The width of the key (2)

5.2.2 The length of the key (2)

5.2.3 The thickness of the key at the bigger end (2)

5.2.4 The thickness of the key at the smaller end (4)

5.3 Explain the functions of the following components on the dividing head used on a milling machine:

5.3.1 Index plate (2)

5.3.2 Sector arms (2)

5.4 State TWO methods that may be used on a centre lathe to cut external V-screw threads with a single-point screw-cutting tool. (2)

### QUESTION 6: JOINING METHODS

6.1 State TWO causes of EACH of the following welding defects:

6.1.1 Undercutting (2)

6.1.2 Lack of fusion (2)

6.2 Explain how the ultrasonic test is conducted on a welding joint. (6)

6.3 State ONE advantage of conducting an ultrasonic test rather than an X-ray test on a welding joint. (1)

6.4 An X-ray test is conducted on a welded joint. How are the results observed and recorded? (2)

6.5 Explain the purpose of the dye penetration test on a welding joint. (2)

6.6 Give TWO examples of destructive tests that are conducted on welded joints. (2)

6.7 Name TWO gases used with MIG/MAGS welding. (2)



**QUESTION 4: MATERIALS**

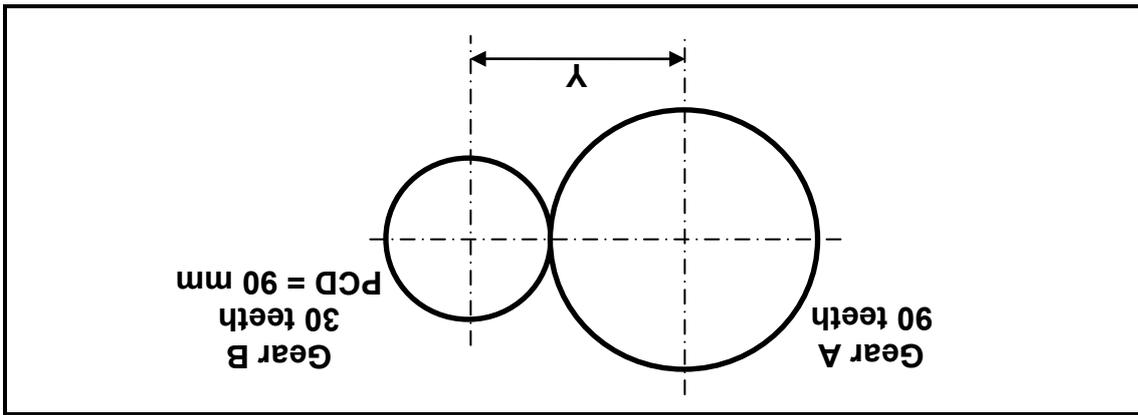
- 4.1 State TWO properties of the cementite structure of carbon steel. (2)
- 4.2 What is the purpose of case hardening on a camshaft? (2)
- 4.3 What is the purpose of tempering hardened steel? (2)
- 4.4 Show, by means of a neat drawing, the following elements on an iron-carbon equilibrium diagram: (4)

- 4.4.1 Carbon content from 0% to 1,4% (1)
- 4.4.2 Temperature of 0 °C to 1 000 °C (1)
- 4.4.3 AC<sub>1</sub>-line (1)
- 4.4.4 AC<sub>3</sub>-line (1)
- 4.4.5 Austenite structure (1)
- 4.4.6 Ferrite structure (1)
- 4.4.7 Pearlite structure (1)

[13]

**QUESTION 5: TERMINOLOGY**

5.1 FIGURE 5.1 shows two spur gears that mesh.



**FIGURE 5.1**

Use the information above and calculate the:

- 5.1.1 Module of the small gear (2)
- 5.1.2 Outside diameter of the big gear (2)
- 5.1.3 PCD of the big gear (2)
- 5.1.4 Dedendum of the big gear (2)
- 5.1.5 Centre distance between the two gears (distance Y) (3)
- 5.1.6 Required indexing for a gear with 33 teeth (3)



**QUESTION 2: SAFETY**

- 2.1 All personal and environmental safety rules were followed when an operator used a surface grinder. State TWO safety rules that should be followed while the surface grinder is in operation. (2)
- 2.2 Give TWO examples of personal protective equipment that should be used while arc welding. (2)
- 2.3 State TWO safety rules to be taken into account before applying force to a bearing puller. (2)
- 2.4 What is the maximum safe distance between the grinding wheel and the tool rest on a bench grinder? (1)
- 2.5 State THREE safety precautions to be adhered to when a Rockwell hardness tester is used. (3)

**QUESTION 3: TOOLS AND EQUIPMENT**

- 3.1 Give TWO reasons for conducting a bending test on a roof beam. (2)
- 3.2 Give TWO reasons for a high CO reading when conducting a gas analysis test on the engine of a motor vehicle. (2)
- 3.3 State TWO advantages of the MIG/MAGS welding process. (2)
- 3.4 Name TWO tests that can be done with a multimeter. (2)
- 3.5 Due to engine power loss in a vehicle the mechanic conducts a compression test according to certain procedures. Why are the procedures below followed?
- 3.5.1 Remove the high-tension lead. (1)
- 3.5.2 Unplug the fuel-injection system. (1)
- 3.5.3 Open the throttle valve fully. (1)
- 3.5.4 Record the readings. (1)

**[12]**

1.18 Determine the speed ratio of the chain drive of the racing bicycle shown in FIGURE 1.7.

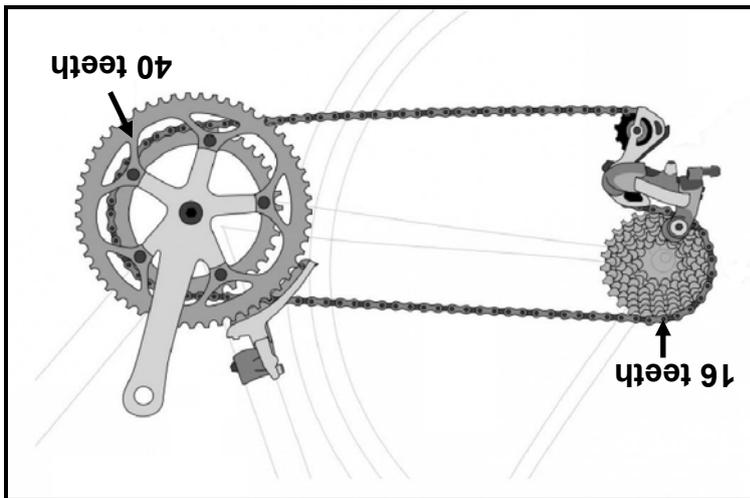


FIGURE 1.7

- A 40 : 1
- B 1 : 40
- C 2,5 : 1
- D 1 : 2,5

(1)

1.19 What is the function of the waste gate in a turbo charger? It releases excess ...

- A pressure.
- B moisture.
- C heat.
- D oil.

(1)

1.20 A steam turbine is used to ...

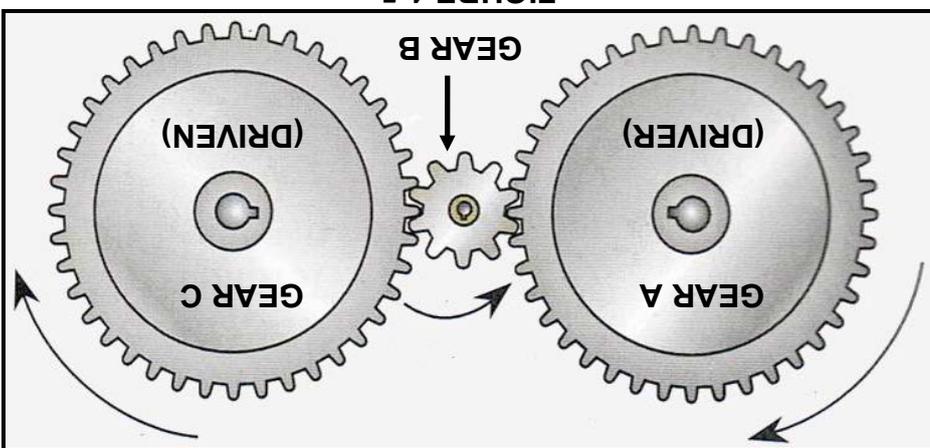
- A increase the fuel consumption in relation to engine output.
- B increase the volumetric efficiency of a four-stroke diesel engine.
- C drive a generator to generate electricity.
- D decrease the atmospheric pressure of an engine.

(1)

[20]



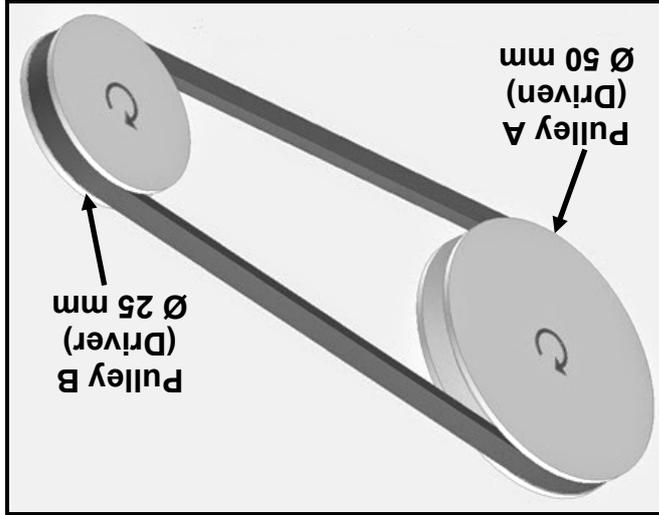
1.16 FIGURE 1.5 shows a gear train with three gears that mesh. What is gear B called?



- A Helical gear
- B Rack
- C Idler gear
- D Pinion

(1)

1.17 What will the rotation frequency of pulley A be if pulley B is rotating at 1 000 r/min, as shown in FIGURE 1.6?



- A 1 000 r/min
- B 2 000 r/min
- C 500 r/min
- D 100 r/min

(1)

FIGURE 1.6



1.13 The law of moments is defined as a system of forces that is in equilibrium if the ...

- A coefficient of the clockwise moments around a point is equal to the coefficient of the anticlockwise moments around the same point.
- B difference of the clockwise moments around a point is equal to the difference of the anticlockwise moments around the same point.
- C sum of the clockwise moments around a point is equal to the sum of the anticlockwise moments around the same point.
- D product of the clockwise moments around a point is equal to the product of the anticlockwise moments around the same point.

(1)

1.14 Which ONE of the following is an advantage of a chain-drive system?

- A Low cost
- B No lubrication needed
- C Smooth operation
- D Slip-free drive

(1)

1.15 Which step in adjusting the tension in a chain of a chain drive is shown at point A in FIGURE 1.4?

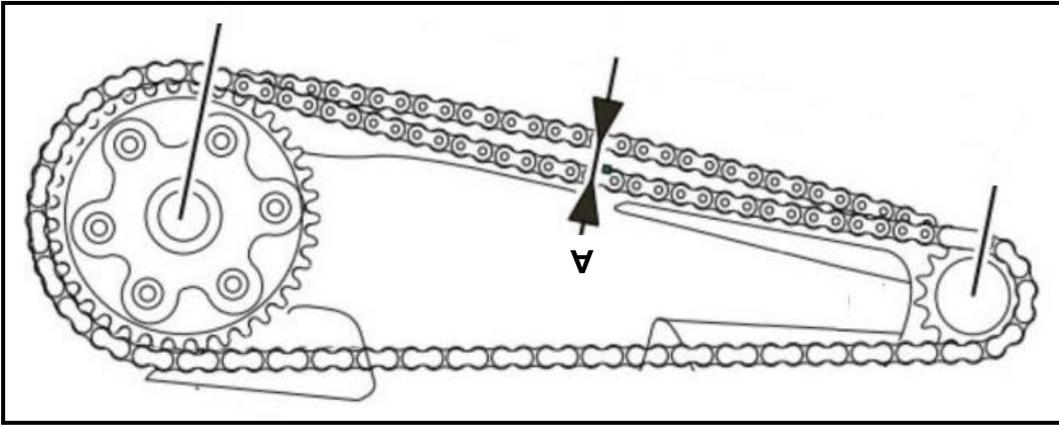


FIGURE 1.4

- A Check the distance between the centres.
- B Slacken the clamp bolts and screw the adjusting bolt in or out.
- C Check the amount of slack in the chain.
- D Tighten the clamping bolts.

(1)



1.11

What does straight line OA represent in the stress-strain graph shown in FIGURE 1.2?

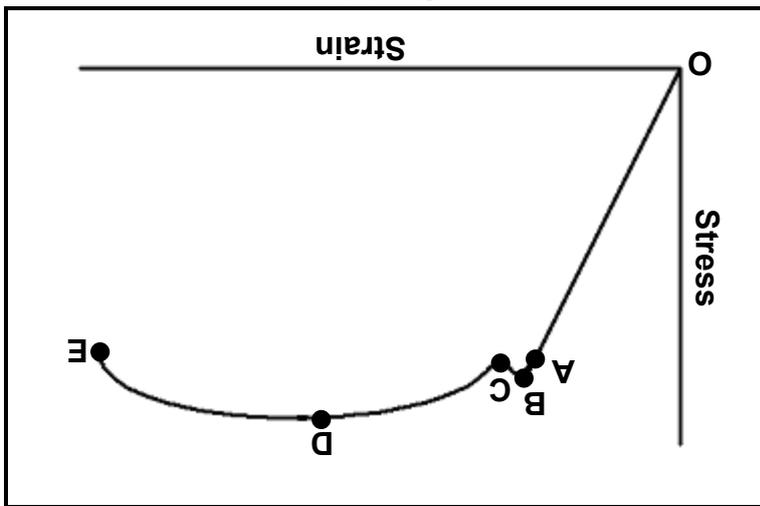


FIGURE 1.2

- A The difference between the stress and strain
- B The indirect proportionality between the stress and strain
- C The proportionality between the stress and strain
- D The similarity between the stress and strain

(1)

1.12

What is the class of the lever shown in FIGURE 1.3?

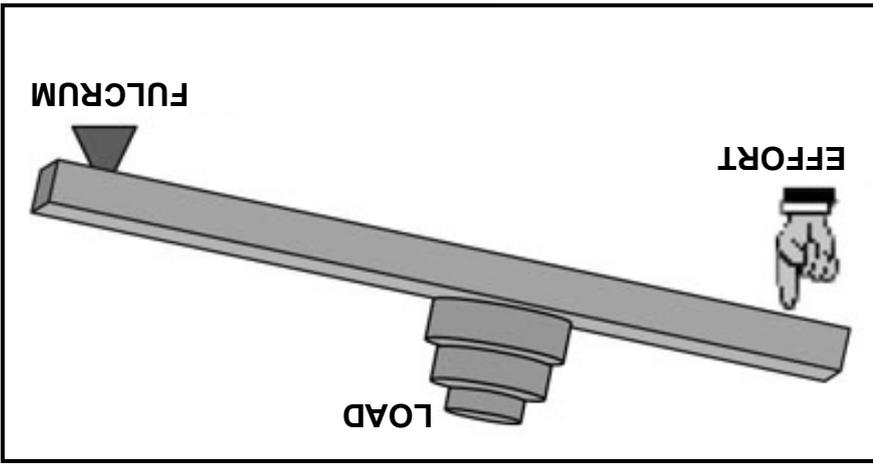


FIGURE 1.3

- A 1<sup>st</sup> class
- B 2<sup>nd</sup> class
- C 3<sup>rd</sup> class
- D 4<sup>th</sup> class

(1)



1.6 The lower critical temperature for carbon steel is ...

- A 100 °C.
  - B 950 °C.
  - C 720 °C.
  - D 610 °C.
- (1)

1.7 Which milling procedure is shown in FIGURE 1.1?

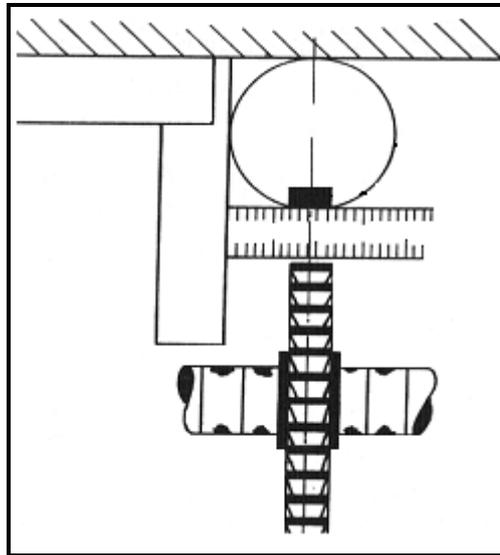


FIGURE 1.1

- A Up-cut milling
  - B Gear cutting
  - C Down-cut milling
  - D Centring of a milling cutter
- (1)

1.8 What is the included angle of a metric V-screw thread?

- A 30°
  - B 29°
  - C 60°
  - D 55°
- (1)

1.9 Which ONE of the following is a common cause of porosity in a welding joint?

- A Dirty or wet electrodes used when arc welding
  - B Slag not cleaned off the first weld surface before a second weld run
  - C Faulty restart by not restarting at the top of the previous weld run
  - D A welding current that is too low
- (1)

1.10 What is the definition of slag inclusion as a welding defect?

- A Metallic solids entrapped in the weld metal
  - B Gas pores occurring in the solidified weld bead
  - C Non-metallic solids entrapped in the weld metal
  - D Melted surface impurities trapped in the weld surface
- (1)



**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.20), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.21  A  B  C  D

1.1 What safety measure must be adhered to with regard to the milling machine, according to the Occupational Health and Safety Act, 1993 (Act 85 of 1993)?

- A Do not use a wrench on revolving work.
- B Remove guards while cutting material.
- C Make sure that the wheel is dressed.
- D Use the machine table as an anvil.

1.2 What safety measure is applicable to the hydraulic press in terms of the Occupational Health and Safety Act?

- A Do not exceed the safe pressure limit.
- B Work at a safe speed.
- C Lubricate the work piece before mounting it on the press.
- D Use the maximum pressure for thicker materials.

1.3 A Brinell tester is used to test the ... of a material.

- A tension
- B elasticity
- C hardness
- D brittleness

1.4 Which ONE of the following statements describes the function of the tensile tester?

- A Determines the length of the material
- B Changes the length of the material
- C Determines the tensile strength of the material
- D Determines the tensile ratio of the material

1.5 A ferrite structure is ...

- A strong and brittle.
- B soft and ductile.
- C hard and brittle.
- D soft and brittle.

(1)



**INSTRUCTIONS AND INFORMATION**

1. This question paper consists of TEN questions.
2. Write your centre number and examination number in the spaces provided on the ANSWER BOOK.
3. Read ALL the questions carefully.
4. Answer ALL the questions.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Start EACH question on a NEW page.
7. Show ALL calculations and units. Round off ALL answers to TWO decimal places.
8. Candidates may use non-programmable, scientific calculators and drawing instruments.
9. Take the value of gravitational force as  $10 \text{ m/s}^2$ .
10. All dimensions are in millimetres, unless stated otherwise in the question.
11. A formula sheet for your use is attached to this question paper.
12. Write neatly and legibly.
13. Use the guidelines below to assist you in managing your time.

QUESTION	CONTENT	MARKS	TIME (minutes)
1	Multiple-choice questions	20	15
2	Safety	10	10
3	Tools and Equipment	12	10
4	Materials	13	10
5	Terminology	30	20
6	Joining Methods	25	25
7	Forces	30	30
8	Maintenance	15	15
9	Systems and Control	25	25
10	Turbines	20	20
<b>TOTAL</b>		<b>200</b>	<b>180</b>





# AFTERNOON SESSION

This question paper consists of 16 pages and a 4-page formula sheet.

TIME: 3 hours

MARKS: 200

**MCHT.1**  
**MECHANICAL TECHNOLOGY**  
**NOVEMBER 2016**

**GRADE 12**

**NATIONAL SENIOR CERTIFICATE**



**basic education**  
Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA