SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

OCTOBER / NOVEMBER
OKTOBER / NOVEMBER

2004

TECHNIKA (MECHANICAL)
TECHNIKA (MEGANIES)

SG **715-2/0**

10 pages
10 *bladsye*

TECHNIKA MECHANICAL SG

715 2 0 SG

APPROVED BY UMALUSI / *GOEDGEKEUR DEUR UMALUSI*

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (MEGANIES) SG

TYD: 3 uur

PUNTE: 200

BENODIGHEDE:

- 'n Sakrekenaar en tekeninstrumente

INSTRUKSIES:

- Beantwoord AL die vrae.
- 'n Inligtingsblad word agter aan hierdie vraestel verskaf. Maak dit asseblief los vir maklike verwysing.

VRAAG 1

1.1	Noem SES belangrike oorsake van brande.	(6)
1.2	Wat is die hoofdoelwit van die Fabriekswet?	(2)
1.3	Noem SES bedryfsiektes en gee die oorsaak van elk.	(12)
1.4	Noem VIER oorwegings ten opsigte van veilige werkstoestande vir werknemers wat by die ontwerp van 'n fabrieksgebou in ag geneem moet word.	(4)
1.5	Wat is 'n werknemer se verantwoordelikheid ten opsigte van bedryfsiektes?	(4)
1.6	Waarom is goeie bedryfshuishouding belangrik in 'n fabriek?	(4)
1.7	Die misbruik van alkohol en dwelms is die sosiale euwel van ons tyd. Noem VYF nadelige gevolge wat sodanige misbruik vir 'n individu, met betrekking tot sy/haar werksituasie en/of gesin, inhou.	(5)
1.8	Noem DRIE eienskappe van 'n goeie bedryfsleier (bestuurder).	(3)
		[40]

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (MECHANICAL) SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- A calculator and drawing instruments

INSTRUCTIONS:

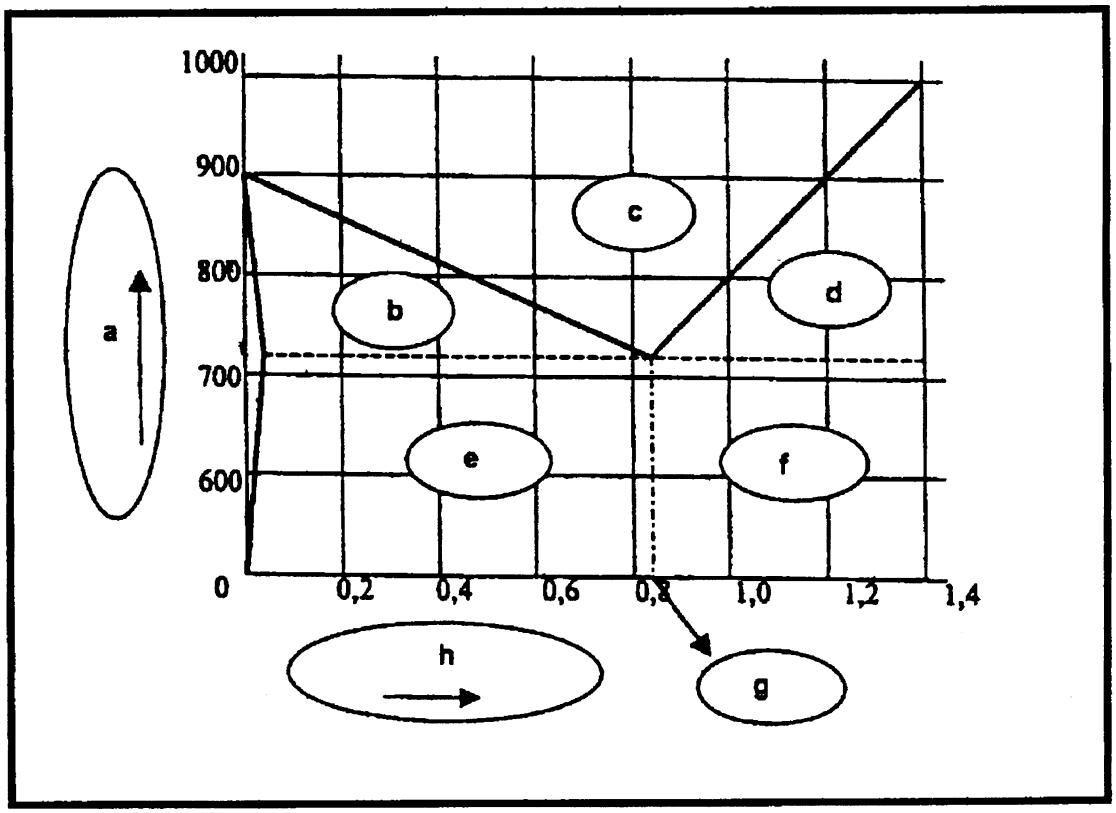
- Answer ALL the questions.
- An information sheet is provided at the back of this question paper. Please detach it for easy reference.

QUESTION 1

1.1	Name SIX main causes of fire.	(6)
1.2	What is the main aim of the Factory Act?	(2)
1.3	Mention SIX occupational diseases and state the cause of each.	(12)
1.4	State FOUR considerations with regard to safe working conditions for employees which must be taken into account when designing a factory building.	(4)
1.5	What is an employee's responsibility with regard to industrial diseases?	(4)
1.6	Why is good industrial housekeeping important in a factory?	(4)
1.7	The abuse of alcohol and drugs is the social evil of our times. State FIVE detrimental consequences of such abuse for an individual's work situation and/or family.	(5)
1.8	Name THREE characteristics of a good works leader (manager).	(3)
		[40]

VRAAG 2

2.1 Bestudeer die onderstaande diagram en verskaf byskrifte vir die genommerde komponente van die koolstof yster-ewewig-diagram. Bepaal ook, met behulp van die diagram, tot watter temperatuur staal, met 'n koolstofinhoud van 1%, verhit moet word om die boonste kritieke temperatuur (AC_3) te bereik. Skryf slegs die letters (a – h) onder mekaar in jou antwoordboek neer en die korrekte antwoord daarteenoor. (10)



2.2 Noem DRIE basiese kristalvorms van staal. (3)

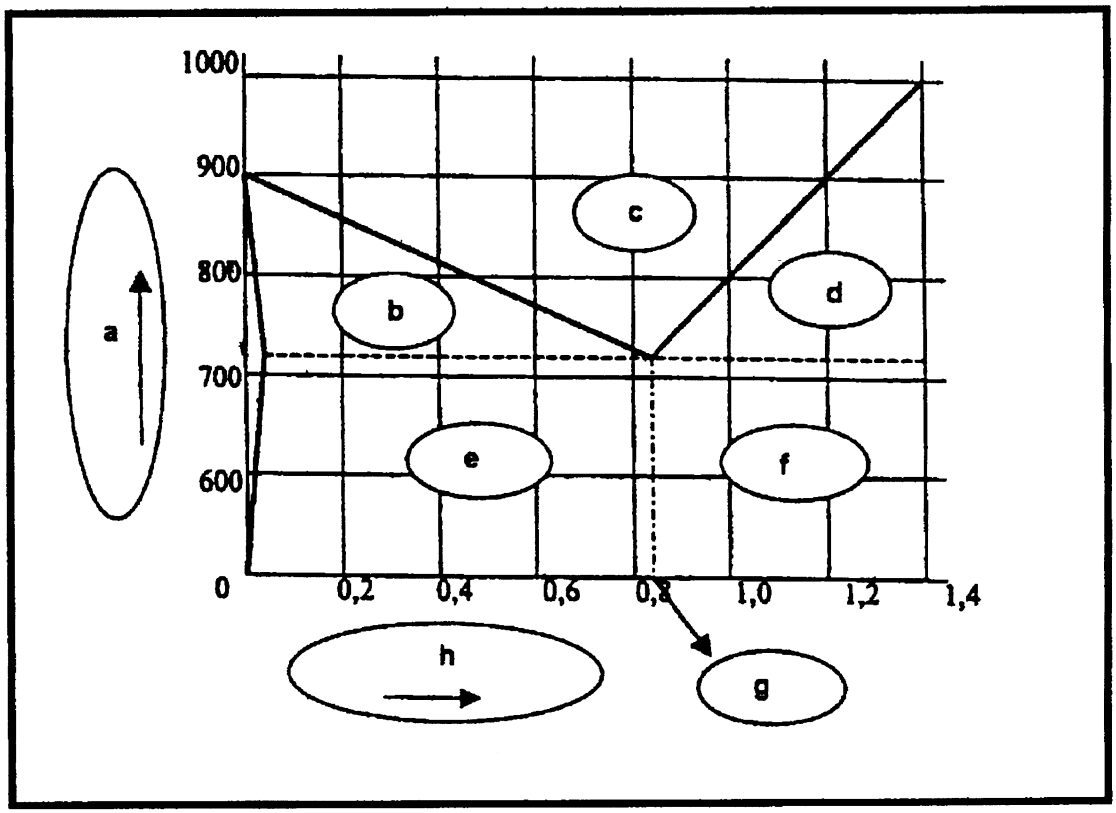
2.3 Beskryf die volgende toetse kortliks en maak van eenvoudige sketse gebruik om jou antwoord te illustreer:

2.3.1 Die Brinell-hardheidstoets (6)

2.3.2 Die Rockwell-hardheidstoets (6)

QUESTION 2

2.1 Study the diagram below and name the labelled components of the carbon-iron equilibrium diagram. Also determine, with the aid of the diagram, the temperature to which steel with a carbon content of 1% must be heated to reach its upper critical temperature (AC_3). Write down only the letters (a – h) below one another in your answer book and the correct answer. (10)



2.2 Name THREE basic crystal structures of steel. (3)

2.3 Describe the following tests briefly and illustrate your answer with the aid of simple sketches:

2.3.1 The Brinell-hardness test (6)

2.3.2 The Rockwell-hardness test (6)

2.4 Die volgende komponente is by die ontwerp van 'n hidrouliese stelsel vir 'n motorhystoestel gebruik:

- Elektriese motor
- Hidrouliese ratpomp
- Geventileerde opgaartenk
- Nieverstelbare drukontlasklep
- Verstelbare drukontlasklep
- Afsluitkleppe
- Eenrigting-klep
- Tweerigtingbeheer-klep (veerbelaai)
- Maatbak
- Enkelaksie-kragsilinder
- Drukmeter
- Filter

Gebruik I.S.O 1219-simbole en ontwerp 'n vloeidiagram vir die hystoestel. (12)

2.5 Definieer die term **druk**. (3)
[40]

VRAAG 3

3.1 Sewe en sestig (67) tande moet op 'n reguittand-rat gefrees word. Die verdeelkopverhouding is 40:1.

3.1.1 Bereken die indeksering benodig. (Kies 70 indelings). (2)
3.1.2 Bereken die wisselratte benodig. (5)
3.1.3 Bepaal die draairigting van die indeksplaat. (2)
3.1.4 Maak 'n eenvoudige skets om die posisie en rangskikking van die wisselratte duidelik aan te toon. (4)

3.2 Waarom maak ons van 'n gekose getal by differensiaalindeksering gebruik? (2)

3.3 Die tweedraadmetode van skroefdraadmeting word gebruik om die hoek van 'n M50 x 5 I.S.O.-skroefdraad te toets. Die afmetings oor die twee stelle drade toon 'n verskil van 7,03 mm. Die diameters van die twee stelle drade is onderskeidelik 1,01P and 0,505P.

Bereken die
3.3.1 grootte van die skroefdraadhoek. (7)
3.3.2 fout, indien enige, in die skroefdraadhoek. (2)

3.4 Noem TWEE freesmetodes. (2)

3.5 'n Ronde staalkabel wat uit 60 draadjies bestaan, moet ontwerp word om 'n belasting van 80 kN te kan weerstaan. Bereken die diameter van elk van die draadjies indien die belasting in die kabel nie 120 MPa mag oorskry nie. (8)

3.6 Noem DRIE soorte spanning en maak eenvoudige sketse om jou antwoord te illustreer. (6)
[40]

b.o.

2.4 The following components were used in the design of a hydraulic system for a car hoist:

- Electric motor
- Hydraulic gear pump
- Ventilated reservoir
- Non-adjustable pressure relief valve
- Adjustable pressure relief valve
- Shut-off valves
- Check valve – (one way)
- Two-way-control valve (spring loaded)
- Measuring vessel
- Single-acting power cylinder
- Pressure gauge
- Filter

Use I.S.O 1219 symbols and design a flow diagram for the hoist. (12)

2.5 Define the term **pressure.** (3)
[40]

QUESTION 3

3.1 Sixty seven (67) teeth must be milled on a spur gear. The dividing head ratio is 40:1.

3.1.1 Calculate the indexing required (Choose 70 divisions). (2)
3.1.2 Calculate the change gears required. (5)
3.1.3 Determine the direction of rotation of the index plate. (2)
3.1.4 Make a simple sketch to indicate the position and arrangement of the change wheels. (4)

3.2 Why do we make use of a chosen number with differential indexing? (2)

3.3 The two-wire method of screw thread measurement is used to test the angle of a M50 x 5 I.S.O. screw thread. The measurements across the two sets of wires show a difference of 7,03 mm. The diameters of the two sets of wires are 1,01P and 0,505P respectively.

Calculate the
3.3.1 size of the screw-thread angle. (7)
3.3.2 error, if any, in the screw angle. (2)

3.4 Name TWO types of milling methods. (2)

3.5 A round steel cable comprising 60 strands, has to be designed to be able to withstand a load of 80 kN. Calculate the diameter of each of the strands if the load on the cable may not exceed 120 MPa. (8)

3.6 Name THREE types of stress, and illustrate your answer with the aid of simple sketches. (6)
[40]

VRAAG 4

4.1 Die volgende gegewens het betrekking op 'n sessilinder-vierslag-binnebrandenjin:

Silinderdiameter	90 mm
Slaglengte	110 mm
Gemiddelde effektiewe druk op suier	928 kPa
Omwentelinge per minuut	3 500 rpm
Effektiewe remarm-lengte	1 200 mm
Skaallesing	4,5 kg

Bereken die volgende:

4.1.1 Die aangeduide drywing in kW (7)

4.1.2 Die arbeid verrig gedurende een kragslag wanneer die suier van B.D.P. na O.D.P. beweeg. (3)

4.1.3 Die remdrywing in kW (4)

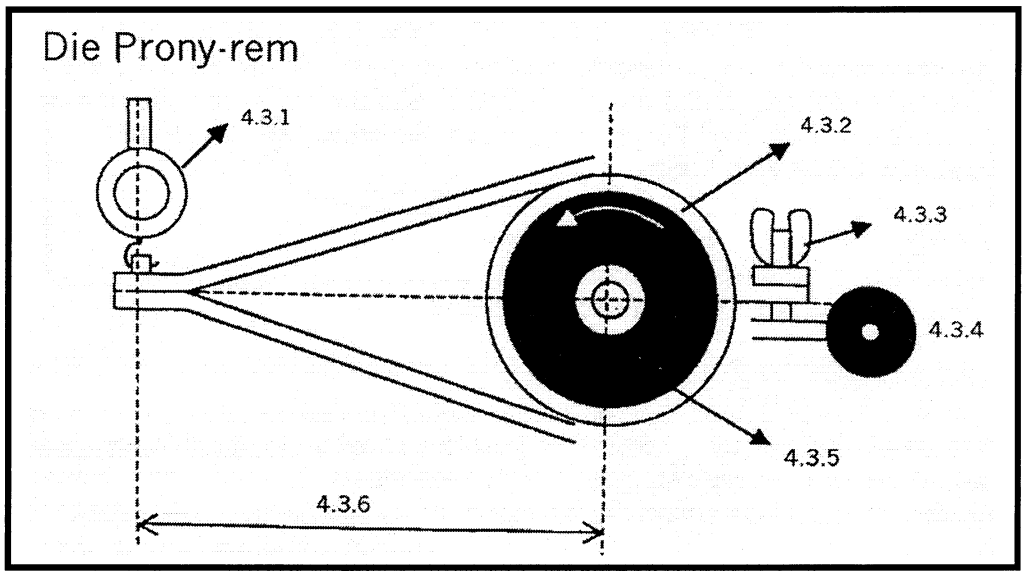
4.1.4 Die meganiese rendement van die enjin (3)

4.2 Definieer die volgende begrippe:

4.2.1 Die **gemiddelde effektiewe druk** op die suier van 'n binnebrandenjin (3)

4.2.2 Aangeduide drywing (3)

4.3 Bestudeer die onderstaande diagram en benoem die genommerde komponente van die Prony-rem wat gebruik word om remdrywing te toets. Skryf slegs die nommers (4.3.1 – 4.3.6) onder mekaar neer en die korrekte antwoord daarteenoor. (6)



4.4 Skets DRIE soorte spye wat algemeen gebruik word. (3)

4.5 Bereken die wydte (breedte), lengte en dikte van 'n gewone parallelspy wat gebruik word om 'n komponent aan 'n 50 mm-diameter-skag (-as) vas te heg. (6)

4.6 Wat is die doel van 'n spy in 'n transmissiestelsel? (2)

[40]

b.o.

QUESTION 4

4.1 The following data is provided for a six-cylinder, four-stroke internal combustion engine:

Cylinder diameter	90 mm
Stroke length	110 mm
Mean effective pressure on piston	928 kPa
Revolutions per minute	3 500 rpm
Effective brake arm length	1 200 mm
Reading on scale	4,5 kg

Calculate the following:

4.1.1 The indicated power in kW (7)

4.1.2 The work done during one power stroke if the piston moves from the TDC to the BDC (3)

4.1.3 The brake power in kW (4)

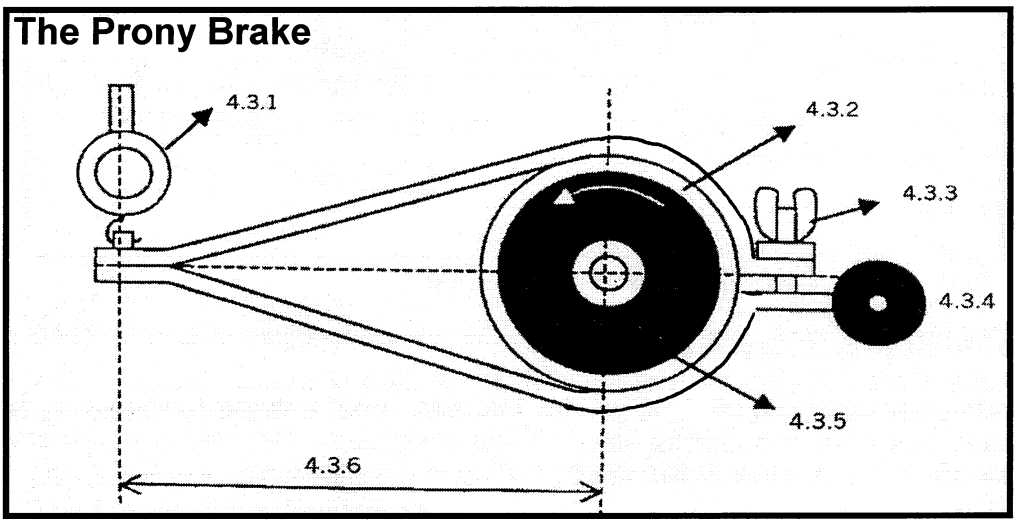
4.1.4 The mechanical efficiency of the engine (3)

4.2 Define the following concepts:

4.2.1 The **mean effective pressure** on the piston of an internal combustion engine (3)

4.2.2 Indicated power (3)

4.3 Study the diagram below and name the numbered components of the Prony brake that is used to test brake power. Write down only the numbers (4.3.1 – 4.3.6) below one another and the correct answer next to it. (6)



4.4 Sketch THREE types of keys in common use. (3)

4.5 Calculate the width, length and thickness of an ordinary parallel key that is used to secure a component to a 50 mm diameter shaft. (6)

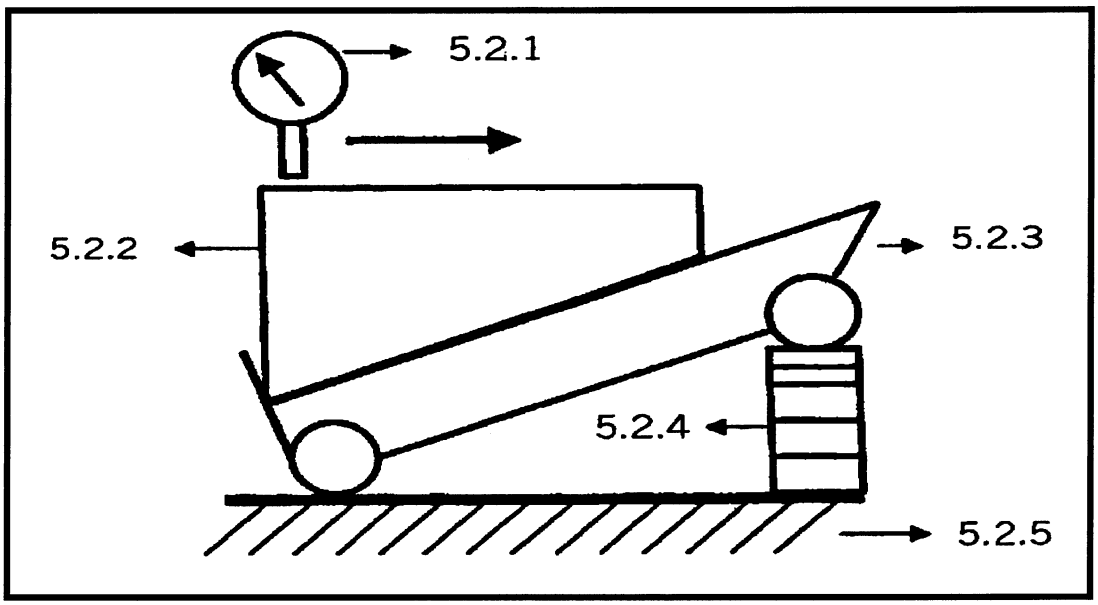
4.6 What is the purpose of a key in a transmission system? (2)

[40]

VRAAG 5

5.1 Teken die simbool wat gebruik word om 'n transistor in 'n elektriese stroombaan aan te dui. Benoem al die komponente. (6)

5.2 Bestudeer die onderstaande diagram en benoem die instrumente wat gedurende 'n akkuraatheidstoets gebruik word. Skryf slegs die nommers (5.2.1 – 5.2.5) onder mekaar neer en die korrekte antwoord daarteenoor. (5)



5.3 Maak gebruik van die tabel van primêre passings op die inligtingsblad en gee die volgende:

5.3.1 Die grense vir 'n I5H7 – p6-gat-as-kombinasie (4)
5.3.2 Die soort passing (1)
5.3.3 Die toelating vir die passing (3)

5.4 Noem DRIE maniere waarop jy jou werknemers bewus kan maak van die groeiende Vigs-krisis in ons land. (3)

5.5 'n Motorvoertuigenjin het 'n massa van 540 kg en word deur middel van 'n hyskraan tot 'n hoogte van 1,2 m van die grond af opgelig.

Bereken die

5.5.1 toename in potensiële energie. (3)
5.5.2 krag wat nodig is om die enjin sonder versnelling op te lig. (3)
5.5.3 arbeid wat verrig word om die enjin tot 'n hoogte van 1,2 m te lig. (3)

5.6 Noem NEGE komponente van 'n heliese veer, droë enkelplaat-koppelaar. (9)

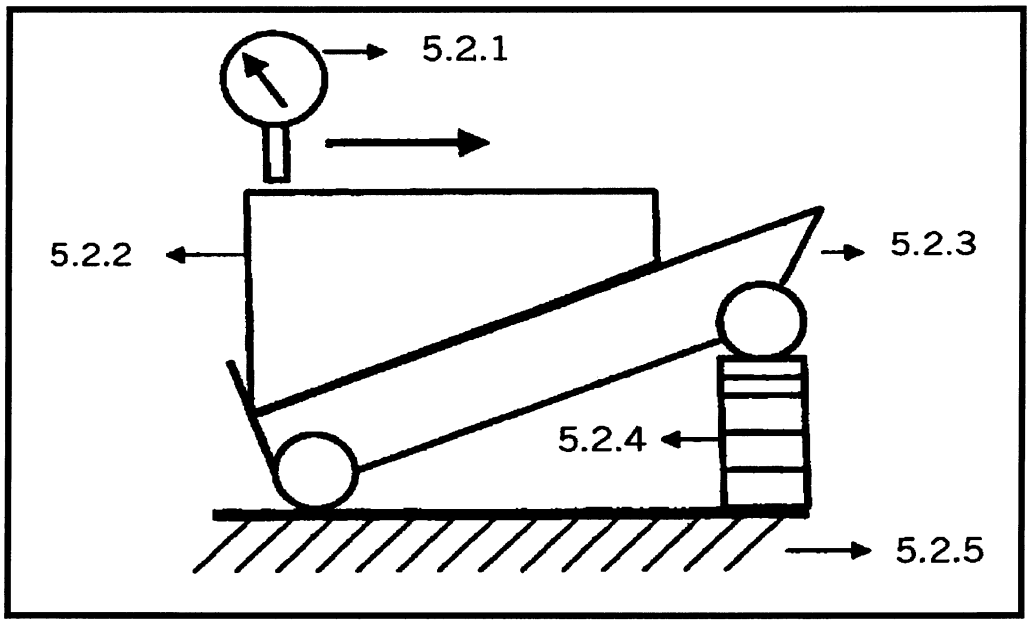
[40]

TOTAAL: 200

QUESTION 5

5.1 Draw the symbol that is used to represent a transistor in an electrical circuit. Label all the components. (6)

5.2 Study the diagram below and name the instruments that are used when conducting an accuracy test. Write down only the numbers (5.2.1 – 5.2.5) below one another and the correct answer. (5)



5.3 Use the table of primary selection of fits on the information sheet and state the following:

5.3.1 The limits for a I5H7 – p6 hole shaft combination (4)
5.3.2 The type of fit (1)
5.3.3 The allowance for this fit (3)

5.4 Name THREE ways in which you can make your employees aware of the growing Aids crisis in our country. (3)

5.5 A motor vehicle engine has a mass of 540 kg and is lifted from ground level to a height of 1,2 m by means of a crane (hoist).

Calculate

5.5.1 the gain in potential energy. (3)
5.5.2 the force required to lift the engine without acceleration. (3)
5.5.3 the work done to lift the engine to a height of 1,2 m. (3)

5.6 List NINE components of a single-plate helical spring dry clutch. (9)

[40]

TOTAL: 200

INFORMATION PAGES / INLIGTINGSBLADSYE

1. **Tooth gears for milling machine / Tandratte vir freesmasjien**
   Standard and special wheels / Standaard- en spesiale wiele

   24 (two of these / twee van hierdie); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 and/en 100 teeth / tande

2. **Index plate for milling machine / Indeksplaat vir freesmasjien**

   Standard Cincinnati index machine / Standaard-Cincinnati-indeksmasjien 24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 53; 54; 57; 58; 59; 62 and/en 66 holes/gate

3. **Take π = 3,14 / Neem π = 3,14**

4. **Take g = 10 m.s^{-2} / Neem g = 10 m.s^{-2}**

5. **Formulae / Formules**

   5.1 **Indexing / Indeksering:**

   5.1.1 **Simple indexing / Eenvoudige indeksering =** $\frac{40}{N}$

   [Dr = Drive gear / Dryfrat]
   [Dn / Gd = Driven gear / Gedrewe rat]

   5.1.2 **Differential indexing / Differensiaalindeksering =** $\frac{Dr}{Gdr} = \frac{(A-N)}{A} \times \frac{40}{1}$

   5.2 **Two-wire method of screw-thread measurement / Tweedraadmetode van skroefdraadmeting:**

   Calculation of included angle / Berekening van ingeslote hoek:

$$\sin\frac{\theta}{2} = \frac{R-r}{\frac{(M-m)}{2}+r-R}$$

   5.3 **Friction: Co-efficient of friction / Wrywing: Wrywingskoëffisiënt** $\mu = \frac{F}{R}$

   5.4 **Stress / Spanning =** $\frac{f}{A}$

5.5 Cross-sectional area of solid cylinder / Dwarsdeursnee-area van soliede silinder = $\frac{\pi D^2}{4}$

5.6 Cross-sectional area of hollow cylinder / Dwarsdeursnee-area van hol silinder = $\frac{\pi(D^2 - d^2)}{4}$

5.7 $E = \frac{\text{Stress}}{\text{Strain}} / E = \frac{\text{Spanning}}{\text{Vormverandering}}$

5.8 $\text{Strain} = \frac{\text{Change in length}}{\text{Original length}} / \text{Vormverandering} = \frac{\text{Verandering in lengte}}{\text{Oorspronklike lengte}}$

5.9 $\text{Factor of Safety} = \frac{\text{Ultimate stress}}{\text{Working stress}} / \text{Veiligheidsfaktor} = \frac{\text{Breekspanning}}{\text{Werkspanning}}$

5.10 Angular acceleration / Hoekversnelling = $\frac{\omega_2 - \omega_1}{t}$

5.11 Torque T / Draaimoment $T = mk^2\omega^2$

5.12 Moment of inertia / Traagheidsmoment $I = mk^2$

5.13 Angular velocity / Hoeksnelheid $\omega = \frac{2\pi n}{60}$

5.14 Kinetic energy of a flywheel / Kinetiese energie van 'n vliegwiel
$E_k = \frac{1}{2} mk^2\omega^2$

5.15 Belt drives / Bandaandrywings

5.15.1 Power P / Drywing $P - (T_1 - T_2)\ \pi\ Dn$

5.15.2 $D_{Dr} \times N_{Dr} = D_{DN} \times N_{DN}$ (Dr = Driver pulley)
(Dn = Driven pulley)

$D_{Dr} \times N_{Dr} = D_{Gdr} \times N_{Gdr}$ (Dr = Dryfkatrol)
(Gdr = Gedrewe katrol)

5.16 Gear drives / Rataandrywings

5.16.1 $N_A \times T_A = N_B \times T_B$

5.16.2 $\frac{\text{Revolutions of final driven gear}}{\text{Revolutions of first drive gear}} / \frac{\text{Omwentelinge van finale gedrewe rat}}{\text{Omwentelinge van eerste dryfrat}}$

=

$\frac{\text{Product of number of teeth on all drive gears}}{\text{Product of number of teeth on the driven gears}} / \frac{\text{Produk van getal tande op al die dryfratte}}{\text{Produk van getal tande op die gedrewe ratte}}$

5.16.3 Speed ratio = $\frac{\text{Product of number of teeth on all drive gears}}{\text{Product of number of teeth on all driven gears}}$

Spoedverhouding = $\frac{\text{Produk van getal tande van alle dryfratte}}{\text{Produk van getal tande van alle gedrewe ratte}}$

5.17 Power / Drywing

5.17.1 Indicated power IP = pLANn (N = Number of power strokes per second)
Aangeduide drywing AD = pLANn (N = Getal kragslae per sekonde)

5.17.2 Brake power BP / Remdrywing RD = $\frac{2\pi n\, T}{60}$

5.17.3 Torque T / Draaimoment T = Fr

5.17.4 Mechanical efficiency = $\frac{BP}{IP} \times \frac{100}{1}$ / Meganiese rendement $\frac{RD}{AD} \times \frac{100}{1}$

5.18 Motion equations / Bewegingsvergelykings

$v = u + at$	$v = at$	$v = u + gt$	$v = gt$
$s = ut + \frac{1}{2} at^2$	$s = \frac{1}{2} at^2$	$s = ut + \frac{1}{2}gt^2$	$s = \frac{1}{2}gt^2$
$v^2 = u^2 + 2as$	$v^2 = 2as$	$v^2 = u^2 + 2gs$	$v^2 = 2gs$

6. Table of primary fits (hole basis system) / *Tabel van primêre passings (gatbasisstelsel)*

Nominal sizes *Nominale groottes*		CLEARANCE FITS *VRY PASSINGS*												TRANSITION FITS *OORGANGPASSINGS*				INTERFERENCE FITS *SLUITPASSINGS*			
		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*		Tolerance *Toleransie*	
Over *Oor* mm	To *Tot* mm	W11	c11	W9	d10	W9	e9	H8	F7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6
		UNIT / *EENHEID* 0,001 mm																			
10	18	+ 110	- 95	+ 41	- 50	+ 43	- 32	+ 27	- 16	+ 18	- 6	+ 18	- 11	+18	+ 12	+18	+ 23	+ 18	+ 29	+ 18	+ 39
		0	- 205	0	- 120	0	- 75	0	- 34	0	- 17	0	0	0	+ 1	0	+ 12	0	+ 18	0	+ 28
18	30	+ 130	- 110	+ 52	- 65	+ 52	- 40	+ 33	- 20	+ 21	- 7	+ 21	- 13	+ 21	+ 15	+ 21	+ 28	+ 21	+ 35	+ 21	+ 48
		0	- 204	0	- 149	0	- 92	0	- 41	0	- 20	0	0	0	+ 2	0	+ 15	0	+ 22	0	+ 35
30	40	+ 160	- 120																		
		0	- 280	+ 62	- 80	+ 62	- 50	+ 39	- 25	+ 25	- 9	+ 25	- 16	+ 25	+ 18	+ 25	+ 33	+ 25	+ 42	+ 25	+ 59
40	50	+ 160	- 130	0	- 180	0	- 112	0	- 50	0	- 25	0	0	0	+ 2	0	+ 17	0	+ 26	0	+ 43
		0	- 290																		

Selection of Primary Fits (hole basis system)
Seleksie van Primêre Passsings (gatbasisstelsel)

END / *EINDE*