GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (MECHANICAL) SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

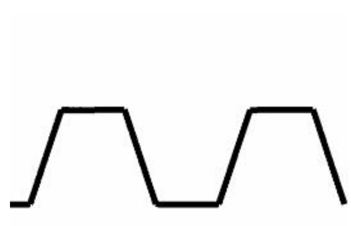
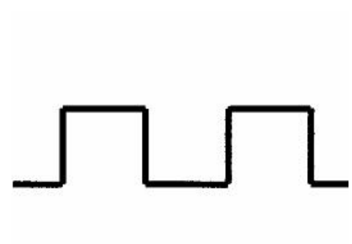
- Calculator
- Drawing instruments
- Information pamphlet (pages 8 to 11)

INSTRUCTIONS:

- Answer ALL questions.

QUESTION 1

1.1 Study Figures 1 to 12 and answer Questions 1.1.1 to 1.13.3.

		
FIGURE 1	**FIGURE 2**	**FIGURE 3**

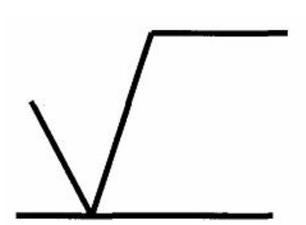
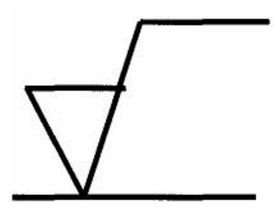
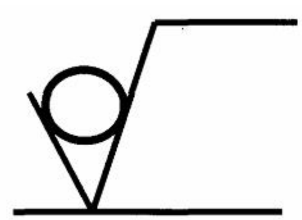

		

FIGURE 4	**FIGURE 5**	**FIGURE 6**

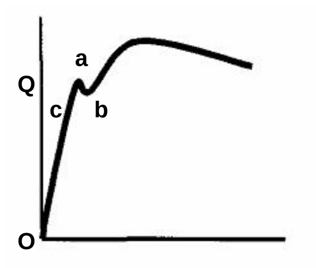


FIGURE 7

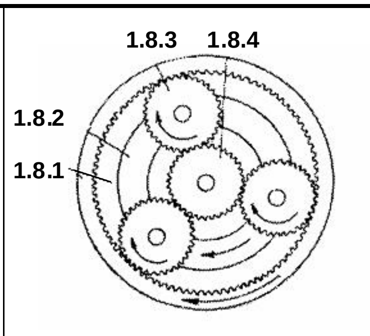


FIGURE 8

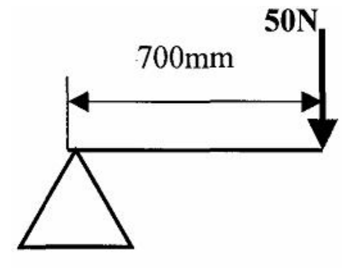


FIGURE 9

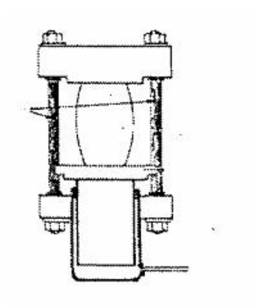


FIGURE 10

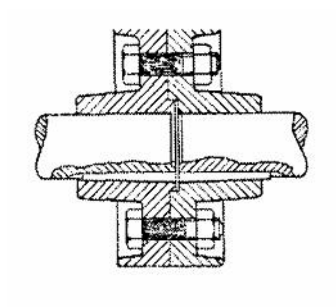


FIGURE 11

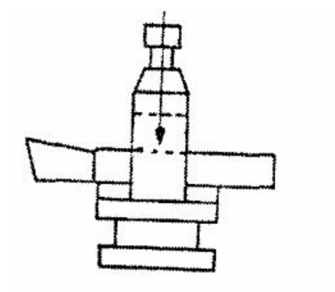


FIGURE 12

1.1.1 What is the meaning of the symbol in **Figure 1**? (2)

1.1.2 Name FIVE ways through which you could make the employees of a business aware of the increasing HIV/Aids crisis in the country. (5)

1.1.3 Explain how HIV/Aids can be spread from one person to another. (4)

1.2 1.2.1 Name the type of screw thread indicated in **Figure 2**. (2)

1.2.2 Give the included angle of the thread in **Figure 2**. (1)

1.2.3 Name THREE uses of the screw thread in **Figure 2**. (3)

1.2.4 Name ONE advantage of the screw thread in **Figure 2** as compared to the square screw thread. (2)

1.3 1.3.1 Name the screw thread in **Figure 3**. (2)

1.3.2 What is the **pitch** of a screw thread? (3)

1.3.3 What is the **lead** of a screw thread? (3)

1.3.4 What is the **included angle** of a thread? (3)

1.3.5 What is the **depth** of a thread? (3)

1.3.6 A square external screw thread having a pitch of 6 mm has to be cut on a lathe. Calculate the depth and width of the screw thread. (6)

1.3.7 What is the use of multi-start screw threads? (2)

1.3.8 State FOUR methods which may be used to cut multi-start screw threads on a lathe. (4)

1.3.9 State TWO factors which determine the size of the helix angle of a screw thread. (2)

1.4 Name the basic surface-finish symbol in **Figure 4**. (2)

1.5 Name the basic surface-finish symbol in **Figure 5**. (2)

1.6 Name the basic surface-finish symbol in **Figure 6**. (2)

1.7 1.7.1 Study **Figure 7** of a typical stress-strain condition graph which is obtained when low-carbon steel (mild steel) is subjected to a destructive tensile test. Name the limits at points **a**, **b** and **c**. (3)

1.7.2 Define the law which is applicable from point **O** to point **Q**. (4)

1.8 1.8.1 Study **Figure 8** and name the components numbered 1.8.1 to 1.8.4 of the epicyclic gear train. Write down only the numbers 1.8.1 to 1.8.4 one below the other in your answer book and the correct answer next to each number. (4)

1.8.2 Describe how the following gear ratios are obtained by means of a single epicyclic gear train.

(a) Reduction gear train (4)

(b) Overdrive ratio (4)

1.9 1.9.1 Study **Figure 9**. A force of 50 N is applied perpendicularly on a horizontal spanner, 700 mm from the turning-centre of the rotation point. Determine the moment of the force. (4)

1.9.2 Define the **law of moments**. (4)

1.10 Name the stress caused in the pillars when the workpiece in **Figure 10** is compressed. (2)

1.11 Name the stress caused in the bolts in **Figure 11** when the flanged coupling is subjected to stress. (2)

P.T.O.

1.12 Name the stress caused when a force clamping the tool in **Figure 12** in the lathe tool post is applied. (2)

1.13 The support leg of a shaping machine table is 20 mm in diameter. If the ultimate stress in the support leg material is given as 80 MPa, calculate:

1.13.1 The safe working stress in the support leg material when a safety factor of 4 is used (3)

1.13.2 The force exerted on the support leg by the safe working stress (4)

1.13.3 The extent by which the support leg will shorten under the load

Given : Young's modulus (E) = 80 x 10^3 MPa
Original length of support leg = 500 mm (7)

[100]

QUESTION 2

2.1 Name SIX occupational diseases and state the cause of each. (12)

2.2 State FOUR characteristics of a good works manager. (4)

2.3 State FOUR facets which are important for successful work stream planning. (4)

2.4 Why is industrial housekeeping important? (5)

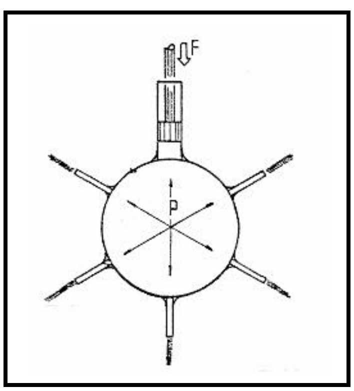
[25]

QUESTION 3

3.1 The fluid pressure in a cylinder, is 9 MPa and the diameter of the cylinder is 0,54 m. Calculate the power exerted when the piston moves outwards. (6)

3.2 Define **hydraulics**. (3)

3.3 Study **Figure 3.1** and define the outcome of the experiment.



Liquid

FIGURE 3.1 (4)

3.4 Study **Figures 3.4.1** and **3.4.2** and define the outcome of the experiment (4)

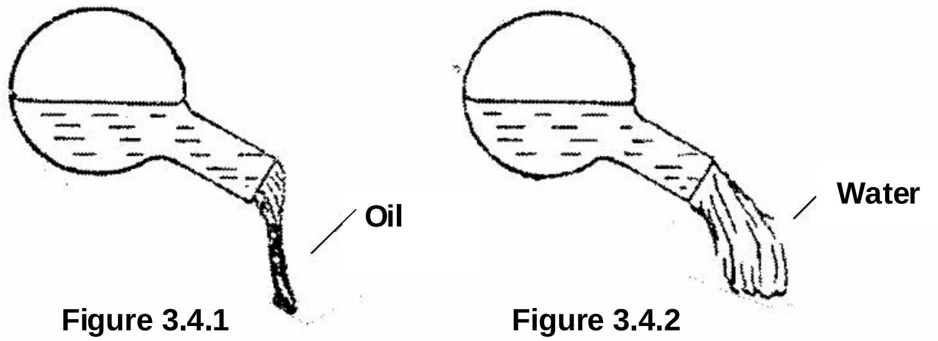


Figure 3.4.1 **Figure 3.4.2**

3.5 Use the **table of primary selection of fits** in the information pamphlet and state the following:

3.5.1 The limits for a **26H7 – g6** hole shaft combination (4)

3.5.2 The type of fit (1)

3.6 Name THREE basic crystal forms of steel. (3)
[25]

QUESTION 4

4.1 Determine the work done in the following cases:

4.1.1 A load of 200 N is lifted vertically for 8 m. Give the answer in kJ. (4)

4.1.2 A wagon with a resistance to motion of 42 N is pushed for 400 m. Give your answer in kJ. (4)

4.2 A rope with a length of 180 metres and a mass of 3,5 kg/metre is used to its full length to hoist a lift with a mass of 480 kg. Calculate the following:

4.2.1 Average tractive force in the rope (6)

4.2.2 Work done (3)

4.2.3 Power required if it takes four minutes to hoist the lift (3)

4.3 Name THREE conditions needed before work could be done. (3)

4.4 Define **power**. (2)
[25]

QUESTION 5

5.1 Give the correct name for the following hydrocarbon compounds in the alkane series:

5.1.1 $\mathbf{C_3H_8}$ (1)

5.1.2 $\mathbf{C_5H_{12}}$ (1)

5.1.3 $\mathbf{C_6H_{14}}$ (1)

5.1.4 $\mathbf{C_7H_{16}}$ (1)

5.1.5 $\mathbf{C_8H_{18}}$ (1)

5.2 Define **Boyle's law**. (4)

5.3 Define **Charles's law.** (4)

5.4 Name the qualities of an ideal gas. (5)

5.5 The following data are provided for a six-cylinder four-stroke internal combustion engine:

Indicated power	115,82 kW
Stroke	110 mm
Mean effective pressure on piston	946 kPa
Revolutions per minute	3 500
Effective brake-arm length	1 200 mm
Reading on scale	17,5 kg

5.5.1 Calculate the cylinder diameter. (7)
[25]

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 p = 3,14 / Neem p = 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 / Differensiaal-indeksering = $\frac{Dr}{Gdr} = \frac{(A - N)}{A} \times \frac{40}{1}$

5.2 Two-wire method of screw-thread measurement / Tweedraad-metode van skroefdraad-meting:

Calculation of included angle / Berekening van ingeslote hoek:

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

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

5.4 Stress / Spanning = $\frac{F}{A}$

5.5 Cross-sectional area of solid cylinder / Dwarsdeursnee-area van soliede silinder = $\frac{pD^2}{4}$ or / *of* $p\ r^2$

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

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

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

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

5.10 Angular acceleration / Hoekversnelling = $\frac{?_2 - ?_1}{t}$

5.11 Torque T / Draaimoment T = $mk^2?^2$

5.12 Moment of inertia / Traagheidsmoment I = mk^2

5.13 Angular velocity / Hoeksnelheid $? = \frac{2\pi N}{60}$

5.14 Kinetic energy of a flywheel / Kinetiese energie van ? vliegwiel

$E_k = \frac{1}{2} mk^2?^2$

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 = $\frac{2\pi NT}{60}$

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 (gatbasis-stelsel)*

Nominal sizes *Nominale groottes*		CLEARANCE FITS *VRY PASSINGS*												TRANSITION FITS *OORGANGPASSINGS*				INTERFERENCE FITS *STUITPASSINGS*			
		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	H11	c11	H9	d10	H9	e9	H8	f7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6
UNIT / *EENHEID* 0,001 mm																					
10	18	+ 110 0	- 95 - 205	+ 43 0	- 50 - 120	+ 43 0	- 32 - 75	+ 27 0	- 16 - 34	+ 18 0	- 6 - 17	+ 18 0	- 11 0	+18 0	+ 12 + 1	+18 0	+ 23 + 12	+ 18 0	+ 29 + 18	+ 18 0	+ 39 + 28
18	30	+ 130 0	- 110 - 204	+ 52 0	- 65 - 149	+ 52 0	- 40 - 92	+ 33 0	- 20 - 41	+ 21 0	- 7 - 20	+ 21 0	- 13 0	+ 21 0	+ 15 + 2	+ 21 0	+ 28 + 15	+ 21 0	+ 35 + 22	+ 21 0	+ 48 + 35
30	40	+ 160 0	- 120 - 280	+ 62 0	- 80 - 180	+ 62 0	- 50 - 112	+ 39 0	- 25 - 50	+ 25 0	- 9 - 25	+ 25 0	- 16 0	+ 25 0	+ 18 + 2	+ 25 0	+ 33 + 17	+ 25 0	+ 42 + 26	+ 25 0	+ 59 + 43
40	50	+ 160 0	- 130 - 290																		

Selection of Primary Fits (hole-basis system)
Seleksie van Primêre Passings (gatbasis-stelsel)

END / *EINDE*