



# higher education & training

---

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL CERTIFICATE**  
**MECHANOTECHNOLOGY N3**

(8190373)

**22 November 2019 (X-Paper)**  
**09:00–12:00**

**This question paper consists of 8 pages, 3 tables and 1 formula sheet.**

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
MECHANOTECHNOLOGY N3  
TIME: 3 HOURS  
MARKS: 100

---



**INSTRUCTIONS AND INFORMATION**

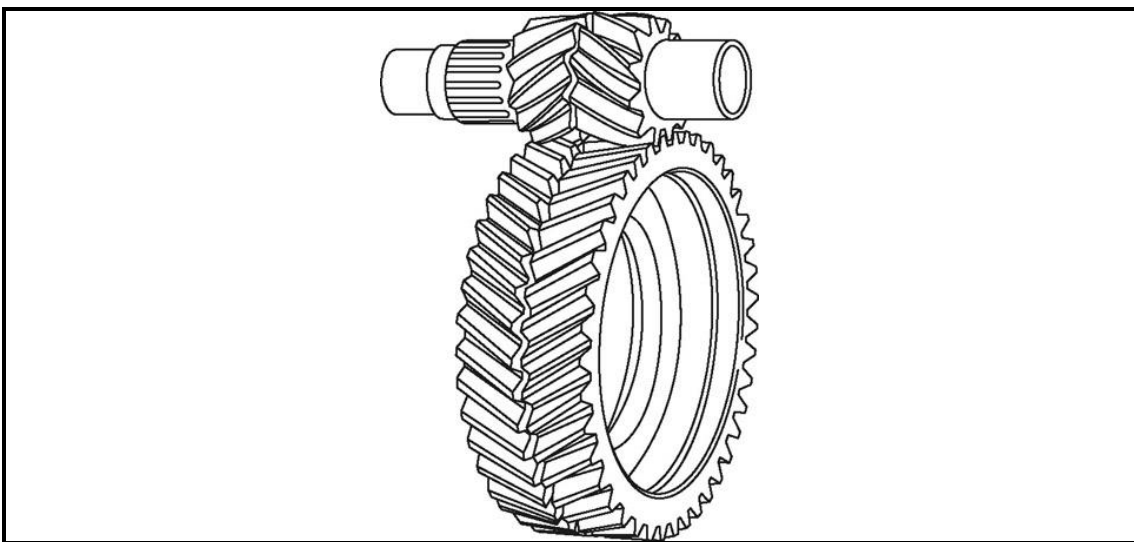
1. Answer ALL the questions.
  2. Read ALL the questions carefully.
  3. Number the answers according to the numbering system used in this question paper.
  4. Start each question on a NEW page.
  5. Write neatly and legibly.
-

**QUESTION 1: POWER TRANSMISSION**

- 1.1 Design a wedge belt drive for a 79 kW electric motor for a reciprocating pump. The pump is to run for 15 hours a day. The driving pulley on the motor rotates at 700 r/min while the pump rotates at 442 r/min. The centre distance between the driving and driven pulleys of the rotary pump is 1 300 mm. The system operates on a soft start. The motor shaft diameter is 100 mm and that of the pump is 120 mm.

Refer to TABLE 1 and TABLE 2 (attached) when answering to the following questions:

- 1.1.1 Calculate the speed ratio  (3)
- 1.1.2 Determine the service factor of the drive (2)
- 1.1.3 Calculate the design power (3)
- 1.1.4 Determine the minimum pulley diameter of the drive (2)
- 1.1.5 Calculate the length of the belt used to drive the system (3)
- 1.2 Explain the following terms applicable to a gear system:
- 1.2.1 Circular tooth thickness (2)
- 1.2.2  Dedendum (2)
- 1.2.3 Circular pitch (2)
- 1.3 Name the gear shown in FIGURE 1.

**FIGURE 1**

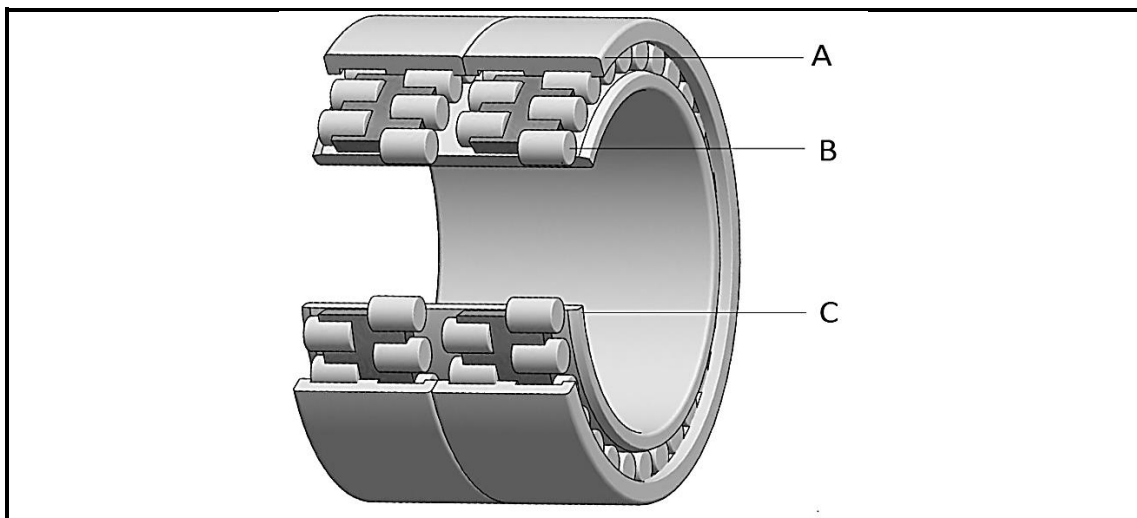
(1)  
[20]

**QUESTION 2: BRAKES**

- 2.1 Discuss the operational principle of a hydraulic braking system. (4)
  - 2.2 State ONE disadvantage of an electromagnetic braking system. (1)
- [5]**

**QUESTION 3: BEARINGS**

- 3.1 Name FIVE types of friction bearings commonly used in the mechanical engineering field. (5)
- 3.2 3.2.1 Name the bearing shown in FIGURE 2. (1)
- 3.2.2 Label the parts indicated on the bearing shown in FIGURE 2 by only writing the answer next to the letter (A–C) in the ANSWER BOOK. (3)



**FIGURE 2**

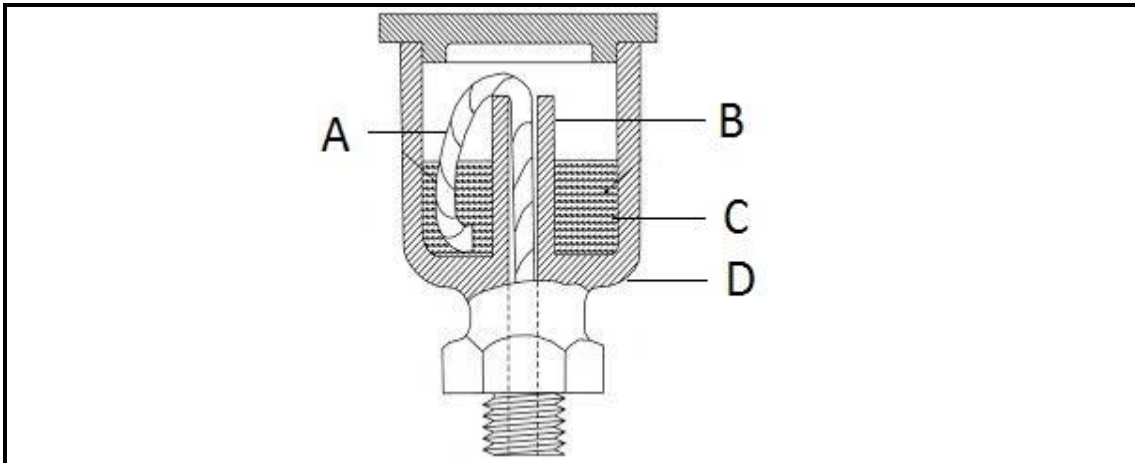
- 3.2.3. Name the severity type of loads that this bearing can carry. (1)
- [10]**

**QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION**

4.1 State FIVE causes of pump slip in water pumps. (5)

4.2 4.2.1 Name the device shown in FIGURE 3. (1)

4.2.2 Name the parts indicated on the device shown in FIGURE 3 by only writing the answer next to the letter (A–D) in the ANSWER BOOK. (4)



**FIGURE 3**

**QUESTION 5: HYDRAULICS AND PNEUMATICS**

5.1 Define *Pascal's law* of pressure of fluids. (2)

5.2 Make a drawing of the following symbols of a basic pneumatic system:

5.2.1 Pressure relief valve (2)

5.2.2 Actuator (2)

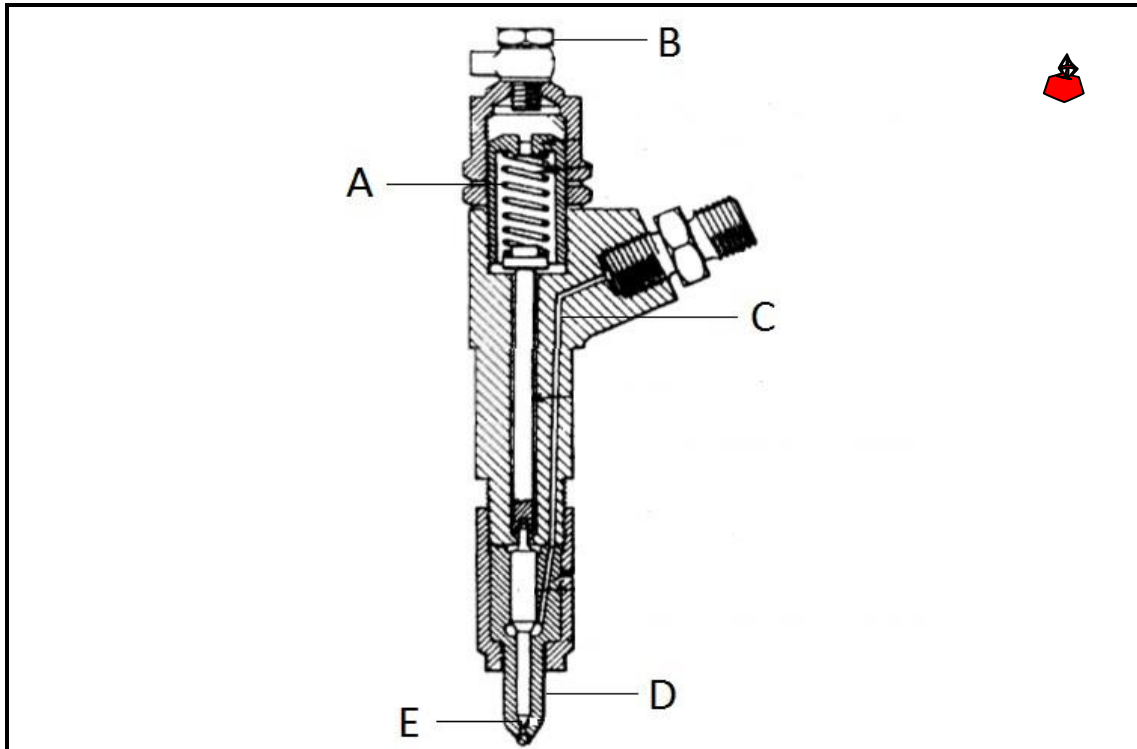
5.2.3 Filter (2)

5.2.4 Air receiver (2)

**[10]**

**QUESTION 6: INTERNAL-COMBUSTION ENGINE**

- 6.1 6.1.1. Name the parts indicated on the device shown in FIGURE 4 by only writing the answer next to the letter (A–E) in the ANSWER BOOK. (5)

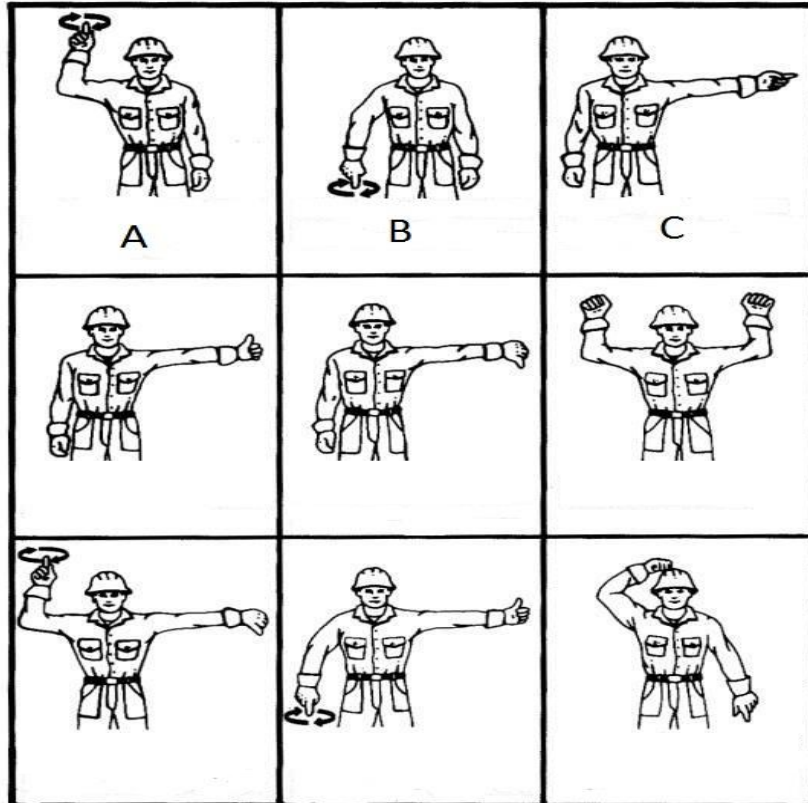


**FIGURE 4**

- 6.1.2. Name the device shown in FIGURE 4 above. (1)
- 6.2 State THREE functions of an engine blower. (3)
- [9]

**QUESTION 7: CRANES AND LIFTING MACHINES**

- 7.1 Explain the basic purpose of a *load limiter*. (2)
- 7.2 Name FOUR factors that can cause steel ropes to deteriorate. (4)
- 7.3 Name the different types of hand signals indicated in the pictures on each block in FIGURE 5. Write only the answer next to the letter (A–C) in the ANSWER BOOK.




**FIGURE 5**

(3)  
[9]


**QUESTION 8: MATERIALS AND MATERIAL PROCESSES**

- 8.1 Define to differentiate between ferrous and nonferrous metals and give ONE example for each of these types of metals. (2 × 2) (4)
- 8.2 Explain the purpose for the colour-coding of metals. (2)  
[6]

**QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING**

- 9.1 Name FOUR types of communication channels in an industrial organisation. (4)
- 9.2 Discuss the purpose of a *grievance procedure*.  (2)
- 9.3 State FIVE production control documents used in an industrial organisation. (5)
- [11]**

**QUESTION 10: ENTREPRENEURSHIP**

- 10.1 Briefly explain the term *small business enterprise*. (3)
- 10.2  State FOUR processes of generating ideas for establishing a small business. (4)
- 10.3 Mention three business resources for the small business entrepreneur. (3)
- [10]**

**TOTAL: 100**



**TABLE 1****SERVICE FACTORS FOR THE SELECTION OF WEDGE BELTS**

<b>TYPES OF DRIVEN MACHINES</b>	<b>TYPES OF PRIME MOVERS</b>					
	<b>'Soft' starts</b>			<b>'Heavy' starts</b>		
	<b>Hours per day duty</b>			<b>Hours per day duty</b>		
	<b>10 and under</b>	<b>Over 10 to 16</b>	<b>Over 16</b>	<b>10 and under</b>	<b>Over 10 to 16</b>	<b>Over 16</b>
Class 1 – Light duty Blowers and fans Centrifugal compressors and pumps Belt conveyors (uniformly loaded)	1,0	1,1	1,2	1,1	1,2	1,3
Class 2 – Medium duty Blowers and fans Rotary compressors and pumps Belt conveyors (not uniformly loaded) Generators	1,1	1,2	1,3	1,2	1,3	1,4
Class 3 – Heavy duty Brick machinery Compressors and pumps (reciprocating) Conveyors (heavy duty) Hammer mills Punches and presses	1,2	1,3	1,4	1,4	1,5	1,6
Class 4 – Extra heavy duty Crushers Mills	1,3	1,4	1,5	1,5	1,6	1,8

TABLE 2

## MINIMUM PULLEY DIAMETER (mm)

Speeds of faster than in r/min	Minimum pulley diameter (mm)																			
	Design power (kW)																			
	To 1	3,0	4,0	5,0	7,5	10	15	20	25	30	40	50	60	75	90	110	130	150	200	250
<b>500</b>	67	90	100	112	125	140	180	200	212	236	250	280	280	315	375	400	450	475	500	560
<b>600</b>	67	85	90	100	112	125	140	180	200	212	224	250	265	280	300	335	375	400	475	500
<b>720</b>	67	80	85	90	90	106	132	150	160	170	200	236	250	265	280	300	335	375	450	500
<b>960</b>	67	75	80	85	95	100	112	132	150	180	180	200	224	250	280	280	300	335	400	450
<b>1 200</b>	67	71	80	80	95	95	106	118	132	150	160	180	200	236	236	250	265	300	335	355
<b>1 440</b>	67	67	75	80	85	85	100	112	125	140	160	170	190	212	236	236	250	280	315	335
<b>1 800</b>	67	67	71	75	80	85	95	106	112	125	150	160	170	190	212	224	236	265	300	335
<b>2 800</b>	67	67	67	67	80	80	85	90	100	112	125	140	160	170	180	212	224	236	-	-

TABLE 3

## CENTRE DISTANCES FOR 22 N SPC WEDGE BELT DRIVES

Combined arc and belt length					0,80			0,85			0,90					0,95						
Correction factor																						
Speed ratio	Pitch diameter of pulleys		Power per belt kW		BELT LENGTH																	
	Driver	Driven	960 r/min	1 440 r/min	2 000	2 120	2 240	2 360	2 500	2 650	2 800	3 000	3 150	3 350	3 550	3 750	4 000	4 250				
1,58	400	630	37,85	49,15	-	-	-	-	-	-	580	682	758	859	960	1 060	1 186	1 311				
1,58	300	475	25,19	33,63	-	443	504	565	636	711	787	887	963	1 063	1 163	1 264	1 389	1 514				
1,58	224	355	14,82	19,80	542	602	662	723	793	868	943	1 043	1 119	1 219	1 319	1 419	1 544	1 669				
1,59	315	500	27,16	36,17	-	-	471	532	603	679	755	855	931	1 031	1 131	1 232	1 357	1 482				
1,59	236	375	16,50	22,09	516	576	637	697	767	842	918	1 018	1093	1 193	1 293	1 394	1 519	1 644				
1,60	250	400	18,44	24,71	484	545	605	666	736	811	887	987	1 062	1 162	1 263	1 363	1 488	1 613				
1,60	500	800	49,26	-	-	-	-	-	-	-	-	-	-	-	739	841	968	1 094				

(8190373)

## **MECHANOTECHNOLOGY N3**

### **FORMULA SHEET**

Any applicable formula may also be used.

1. *Corrected power per belt = (basic power per belt + power increment per belt) × correction factor*
2. *Force (F) = Pressure (P) × Area (A)*
3. *Work done (W) = Force (F) × Distance (s)*
4. *Volume (V) = Area of base (A) × Perpendicular height ( $\perp h$ )*