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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

MECHANOTECHNOLOGY N3

(8190373)

23 July (X-Paper)
09:00 – 12:00

Calculators may be used.

This question paper consists of 7 pages, 2 sheets with tables and a 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 correctly according to the numbering system used in this question paper.
4. ALL the drawings must be large, clear, neat and in good proportion.
5. Keep questions and subsections of questions together.
6. Write neatly and legibly.

QUESTION 1: POWER TRANSMISSION

- 1.1 A 22 N SPC wedge belt drive is to be installed between an electrical motor and a belt conveyor. The following information is known:

Speed of the pulley on the electric motor	1 245 r/min
Speed ratio	1,59:1
Design power of electrical motor	36 kW
Duty operation type	'Medium'
Duty hours per day	11 (eleven) hrs
Type of start	'Soft'
Approximate centre distance	$\pm 1\,400$ mm

Refer to TABLE 1 and TABLE 2 (attached).

- | | | |
|-------|---|-----|
| 1.1.1 | Determine the service factor. | (1) |
| 1.1.2 | Determine the pitch diameter of both pulleys. | (2) |

- 1.1.3 Determine the correct centre distance. (1)
- 1.1.4 Determine the length of the belt. (1)
- 1.1.5 Determine the correction factor. (1)
- 1.1.6 Calculate the speed of the belt conveyor pulley in r/min. (2)
- 1.1.7 Calculate the design power. (2)

1.2 Refer to FIGURE 1 of the gear assembly and answer the following questions:

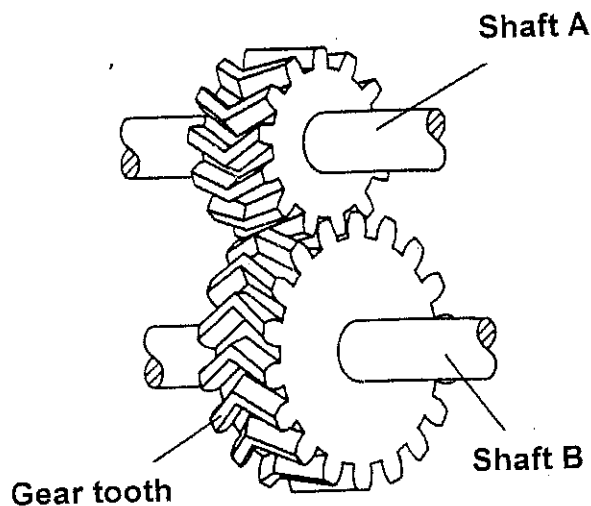


FIGURE 1

- 1.2.1 What type of gears are shown? (1)
 - 1.2.2 State the purposes of this type of gears. (2)
 - 1.3 Name the FOUR main categories that clutches can be grouped in. (4)
 - 1.4 Briefly describe THREE disadvantages of worm and worm-wheel gears. (3)
- [20]

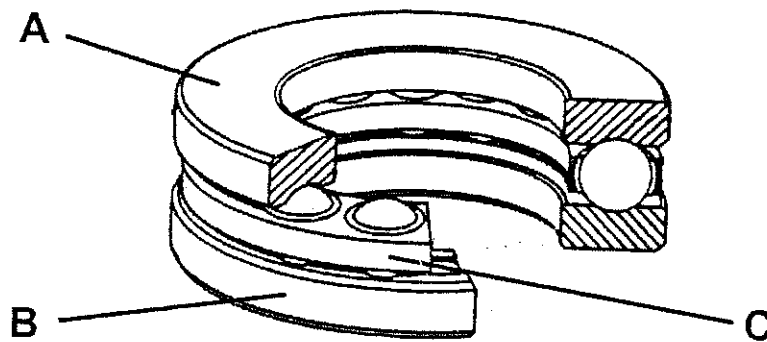
QUESTION 2: BRAKES

Briefly describe FIVE disadvantages of the mechanical brake system.

[5]

QUESTION 3: BEARINGS

- 3.1 The use of a specific type of anti-friction bearing will depend on certain basic factors. State FIVE of these factors. (5)
- 3.2 Refer to FIGURE 2 of the anti-friction bearing and answer the following questions:

**FIGURE 2**

- 3.2.1 Label the different parts (A – C) as indicated. Write the answer next to the letter (A – C) in the ANSWER BOOK. (3)
- 3.2.2 Name the type of load that this bearing is capable of carrying. (1)
- 3.2.3 Name the type of anti-friction bearing. (1)
- [10]**

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

- 4.1 Pump slip can be defined as the difference between the theoretical and real flow rate. Briefly describe FIVE reasons for this. (5)
- 4.2 Briefly explain the term *cavitation* with regard to water pumps. (2)
- 4.3 Briefly describe THREE disadvantages of the direct cooling system in contrast with the indirect cooling system. (3)

4.4 Refer to FIGURE 3 of the water unit and answer the following questions:

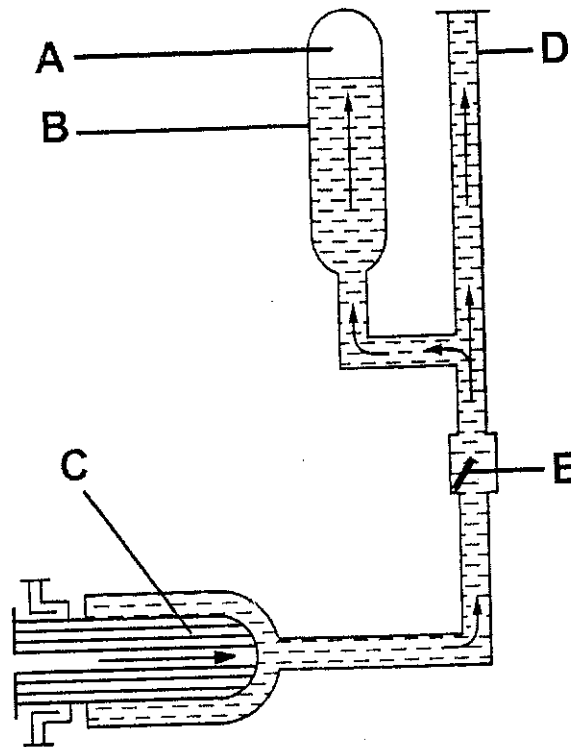


FIGURE 3

- 4.4.1 Label the different parts (A – E) as indicated. Write the answer next to the letter (A – E) in the ANSWER BOOK. (5)
- 4.4.2 Briefly describe the purpose of part B. (1)
- [16]

QUESTION 5: HYDRAULICS AND PNEUMATICS

- 5.1 The work done in cylinder B causes a force of 850 N to be exerted in cylinder A of a hydraulic system. Assume no loss of energy.
Use $\pi = 3,1416$

The area of plunger A = $0,6 \text{ m}^2$
The area of plunger B = $0,2 \text{ m}^2$

- 5.1.1 Calculate the diameter of plunger A in mm. (2)
- 5.1.2 Calculate the force exerted on plunger B. Express the answer in N. (3)

- 5.2 Refer to FIGURE 4 of the line diagram of a basic hydraulic system and answer the following question.

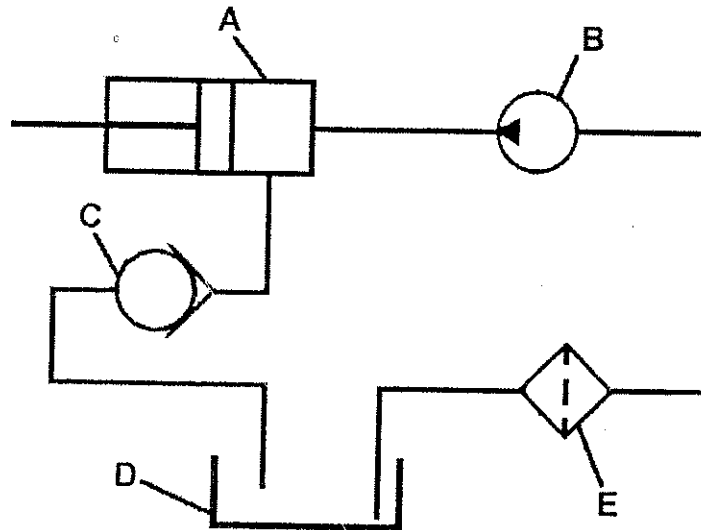


FIGURE 4

Label the different parts (A – E) as indicated. Write the answer next to the letter (A – E) in the ANSWER BOOK.

(5)
[10]

QUESTION 6: INTERNAL COMBUSTION ENGINES

- 6.1 Briefly describe THREE functions of a blower when fitted to a two-stroke diesel engine. (3)
- 6.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (6.2.1 – 6.2.2) in the ANSWER BOOK.
- 6.2.1 The working principle of the two-stroke petrol engine is based on four phases, namely the induction phase, compression phase, power phase and exhaust phase. (1)
- 6.2.2 The combustion chamber of a diesel engine is relatively larger when compared to that of a petrol engine. (1)

(1)
[5]

QUESTION 7: CRANES AND LIFTING MACHINES

- 7.1 Briefly describe THREE advantages of the load limiter as a safety device on an overhead travelling crane. (3)
- 7.2 Give FOUR reasons for the distortion of the lay of a steel rope. (4)
[7]

QUESTION 8: MATERIAL AND MATERIAL PROCESSES

- 8.1 Metals are identified according to their colour codes in the industry. Give the identifying colour codes for the following metals as standardised by the SABS for:
- | | | |
|-------|-------------------|-----|
| 8.1.1 | Pipeline steel | (1) |
| 8.1.2 | High carbon steel | (1) |
| 8.1.3 | Low alloy steel | (1) |
| 8.1.4 | Low carbon steel | (1) |
- 8.2 Briefly describe the general behaviour of aluminium when it is hit with a hammer. (3)
[7]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

- 9.1 Name FOUR types of disciplinary actions that an enterprise can take against any personnel member. (4)
- 9.2 Briefly describe FOUR advantages of a written communication. (4)
- 9.3 Downward communication is a method of communicating from management to staff. Describe FOUR methods how this downward communication can be promoted in an organisation. (4)
[12]

QUESTION 10: ENTREPRENEURSHIP

- 10.1 Briefly explain the term *entrepreneurship*. (4)
- 10.2 State FOUR personal factors of a prospective entrepreneur that could influence the success of any new business. (4)
[8]

TOTAL: 100

TABLE 1

SERVICE FACTORS FOR THE SELECTION OF WEDGE BELTS

TYPES OF DRIVEN MACHINES	TYPES OF PRIME MOVERS					
	'Soft' starts			'Heavy' starts		
	Hours per day duty			Hours per day duty		
	10 and under	Over 10 to 16	Over 16	10 and under	Over 10 to 16	Over 16
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

CENTRE DISTANCES FOR 22 N SPC WEDGE BELT DRIVES

Combined arc and belt length				0,80				0,85				0,90				0,95			
Correction factor				BELT LENGTH															
Speed Ratio	Pitch diameter of pulleys		Power per belt kW		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	
	Driver	Driven	960 r/min	1 440 r/min															
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	1 093	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	

MECHANOTECHNOLOGY N3**FORMULA SHEET**

Any applicable formula may also be used.

1. *Design power = Power (electrical motor) \times service factor*
2. *Corrected power per belt = (basic power per belt + power increment per belt) \times correction factor*
3. *Belt length (L) = [(Pitch diameter of larger pulley + Pitch diameter of smaller pulley) \times 1,57] + (2 \times Centre Distance)*
4. *Force (F) = Pressure (P) \times Area (A)*
5. *Work done (W) = Force (F) \times Distance (s)*
6. *Volume (V) = Area of base (A) \times Perpendicular height ($\perp h$)*

