



# higher education & training

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

**T990(E)(N23)T**  
**NOVEMBER EXAMINATION**  
**NATIONAL CERTIFICATE**  
**MECHANOTECHNOLOGY N3**

(8190373)

**23 November 2016 (X-Paper)**  
**09:00–12:00**

**This question paper consists of 7 pages, 2 information tables and 1 formula sheet.**

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

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**INSTRUCTIONS AND INFORMATION**

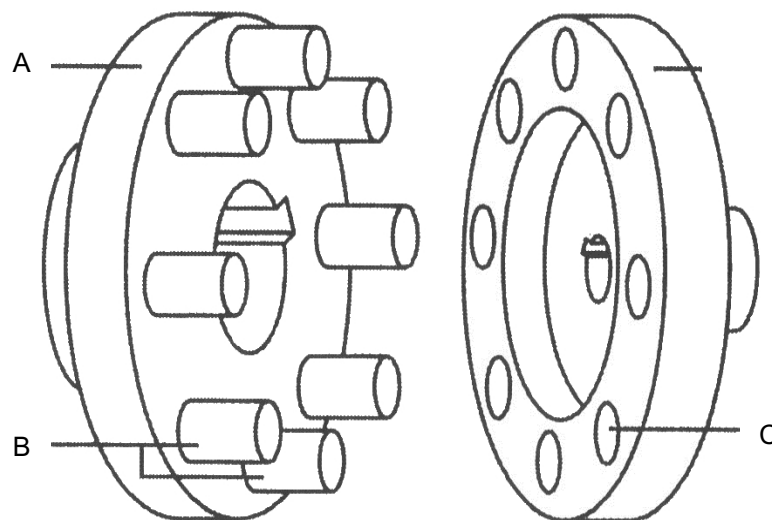
1. Answer ALL the questions.
  2. Read ALL the questions carefully.
  3. Number the answers according to the numbering system used in this question paper.
  4. ALL the drawings must be large, clear, neat and in good proportion.
  5. Keep questions and subsections of questions together.
  6. Write neatly and legibly.
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**QUESTION 1: POWER TRANSMISSION**

1.1 A 105 kW electrical motor which runs at 900 r/min, drives by means of a wedge belt hammer mill at a speed of 570 r/min. This is a heavy-duty operation and performs a 9-hour duty per day. A centrifugal clutch is used for a 'soft start'.

Design this wedge belt drive partly by means of the following steps:

- 1.1.1 Calculate the speed ratio. (2)
- 1.1.2 Refer to TABLE 1 (attached) and find the service factor for this drive. (1)
- 1.1.3 Calculate the design power. (2)
- 1.1.4 Refer to TABLE 2 (attached) and find the minimum pulley diameter. (1)
- 1.2 Define the following terms with regard to the belt drives:
  - 1.2.1 Basic power belt
  - 1.2.2 Corrected power per belt (2 x 2) (4)
- 1.3 List the FOUR main categories into which clutches can be grouped. (4)
- 1.4 Name the TWO parts that hydraulic clutches consist of. (2)
- 1.5 Refer to FIGURE 1 below and answer the questions.



**FIGURE 1**

- 1.5.1 Name the type of coupling shown in Figure 1. (1)
- 1.5.2 Label the parts indicated on FIGURE 1 by writing the answer next to the letter (A–C) in the ANSWER BOOK. (3)

**[20]**

**QUESTION 2: BRAKES**

- 2.1 State TWO disadvantages of the hydraulic braking system. (2)
- 2.2 To operate any brake, some operating principle must activate and de-activate the brake.  
Name THREE operating principles used on brake systems. (3)  
**[5]**

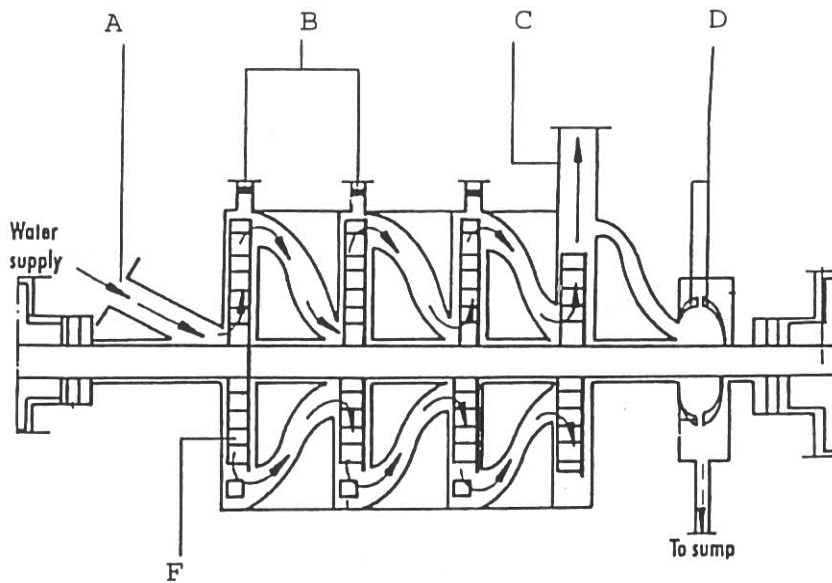
**QUESTION 3: BEARINGS**

- 3.1 Name FOUR shapes of rolling elements used in the anti-friction bearing. (4)
- 3.2 Define the following:
- 3.2.1 Radial load
- 3.2.2 Axial load (2 x 2) (4)
- 3.3 State the TWO factors that largely determine the type and size of the bearing to be used. (2)  
**[10]**

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

- 4.1 Define the following terms:
- 4.1.1 Non-return valve (2)
- 4.1.2 Flood suction (positive suction) (1)
- 4.2 State THREE causes of cavitation in centrifugal pumps. (3)

4.3 Refer to FIGURE 2 below and answer the following questions:



**FIGURE 2**

4.3.1 Name the type of pump indicated in FIGURE 2. (1)

4.3.2 Label the parts indicated on FIGURE 2 by writing only the answer next to the letter (A–D) in the ANSWER BOOK. (4)

4.4 Give FOUR reasons for cooling an electric motor. (4) [15]

**QUESTION 5: HYDRAULICS AND PNEUMATICS**

5.1 A hydraulic system consists of TWO hydraulic cylinders. A force of 1 400 N is applied on the plunger in cylinder A, which is the input cylinder of the system.

The following information is also known:

The work done in cylinder A when the force of 1 400 N is applied: 320 joules.

The diameter of cylinder A: 90 mm

The diameter of cylinder B: 280 mm

Use  $\pi$  as 3,1416

Calculate the following:

5.1.1 The distance that the plunger in cylinder A moves. Express the answer in millimetres (mm). (2)

5.1.2 The volume of fluid displaced in cylinder A during the operation. Express the answer in cubic metres (m<sup>3</sup>). (3)

5.2 Refer to FIGURE 3 of the line diagram of a hydraulic system below and label the different parts (A–E) as indicated. Write only the answer next to the letter (A–E) in the ANSWER BOOK.

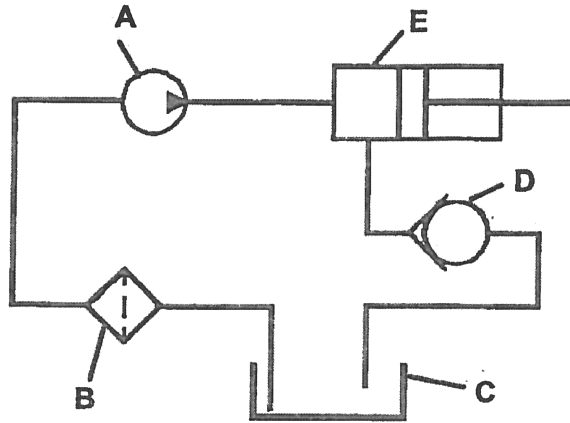


FIGURE 3

(5)  
[10]

**QUESTION 6: INTERNAL COMBUSTION ENGINES**

6.1 State TWO disadvantages of the diesel engine. (2)

6.2 Explain the induction stroke as applicable to the four-stroke diesel engine. (4)

[6]

**QUESTION 7: CRANES AND LIFTING MACHINES**

7.1 State TWO advantages of the crane on a bogie running on rails. (2)

7.2 List THREE types of mounted tower cranes. (3)

7.3 State TWO main functions of the core in a steel wire rope. (2)

[7]

**QUESTION 8: MATERIAL AND MATERIAL PROCESSES**

8.1 State FOUR purposes of annealing as a heat-treatment process. (4)

8.2 Define the following terms:

8.2.1 Iron

8.2.2 Alloy

(2 x 2) (4)

[8]

**QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING**

- 9.1 Give SIX reasons for upward communication. (6)
- 9.2 List FIVE the information that the operator will write on a job card. (5)
- [11]**

**QUESTION 10: ENTREPRENEURSHIP**

- 10.1 Explain the term *SWOT analyses*. (4)
- 10.2 As a spare part dealer, you sold an item for R146,21 to a customer. A mark-up value of 35% and vat of 14% was included in the selling price.
- Calculate the cost price of the spare part. (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
<b>Class 1 – Light duty</b> Blowers and fans Centrifugal compressors and pumps Belt conveyors (uniformly loaded)	1,0	1,1	1,2	1,1	1,2	1,3
<b>Class 2 – Medium duty</b> 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
<b>Class 3 – Heavy duty</b> 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
<b>Class 4 – Extra heavy duty</b> Crushers Mills	1,3	1,4	1,5	1,5	1,6	1,8



TABLE 2

## MINIMUM PULLEY DIAMETER (mm)

Speed 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	-	-

**MECHANOTECHNOLOGY N3****FORMULA SHEET**

Any applicable formula may also be used.

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