



# higher education & training

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

## **NATIONAL CERTIFICATE MECHANOTECHNOLOGY N3**

(8190373)

**5 April 2023 (X-paper)  
09:00–12:00**

**Drawing instruments may be used.**

**This question paper consists of 8 pages, 2-page tables and 1 formula sheet.**

144Q1A2305

**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.  
Start each question on a new page.
  4. Use only a black or a blue pen.
  5. Write neatly and legibly.
  - 6.
-

**QUESTION 1: POWER TRANSMISSION, COUPLING OF SHAFTS, AND CLUTCHES**

- 1.1 A 60 kW electric motor with a speed of 1 500 r/min drives a rotary compressor by means of a wedge belt which rotates at 570 r/min. A centrifugal clutch is used for the heavy start between the two units for a medium-duty operation period of 11 hours. ★
- 1.1.1 Refer to TABLE 1 (attached) and determine the service factor for the drive. (1)
- 1.1.2 Calculate the speed ratio. (2)
- ★ 1.1.3 Refer to TABLE 2 (attached) and calculate the minimum pulley diameter if the design power is 75 kW. (2)
- 1.1.4 Calculate the torque developed by the electric motor. (2)
- 1.2 State FOUR reasons for effectively lubricating a chain drive. (4)
- 1.3 State THREE disadvantages of a worm and worm-wheel gear drive. (3)
- 1.4 Name THREE types of flexible couplings. (3)
- 1.5 The table below shows the causes of slippage in cone clutches and how to overcome them. Choose a remedy from COLUMN B that matches the cause in COLUMN A. Write only the letter (A–D) next to the question number (1.5.1–1.5.3) in the ANSWER BOOK. ★

COLUMN A		COLUMN B	
1.5.1	grease or oil on the contact areas	A	Rub both contact areas with coarse sandpaper
1.5.2	glazing of the friction surfaces due to continual slippage	B	Remove the grease or oil until the contact areas are clean and dry
1.5.3	faulty operation of the control mechanism	C	Test regularly for wear on the pins, links, bushes, etc., and make the necessary adjustments.
		D	Apply more grease to facilitate the smooth operation of a cone clutch.

(3 × 1)

(3)

[20]

**QUESTION 2: BRAKES**

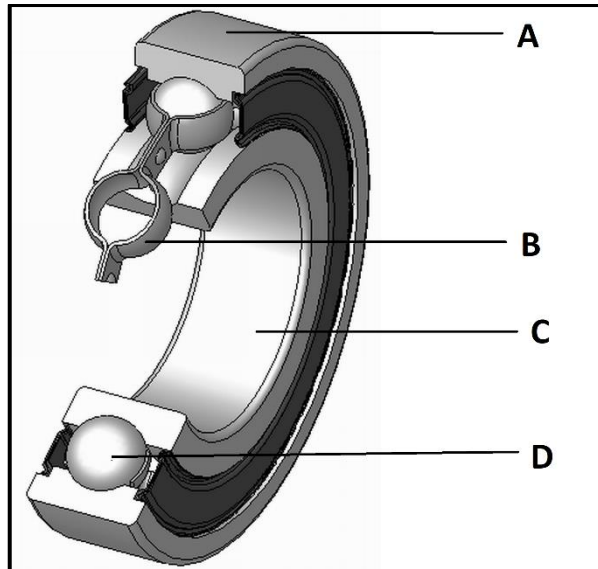
- State FOUR advantages of an external drum and band brake. [4]

**QUESTION 3: BEARINGS**

3.1 Briefly explain the working principle of a friction bearing. (3)

3.2 FIGURE 1 below shows a sketch of a single row radial ball bearing.

Name the parts indicated on the sketch by writing only the answer next to the letter (A–D) in the ANSWER BOOK.



**FIGURE 1**

(4)

3.3 Refer to the table below and answer the following questions:

3.3.1 What is the nominal bore diameter of bearing number 623? (1)



3.3.2 A bearing with a bore diameter of 9 mm must carry a dynamic load of 4 620 N.

Which bearing (number) would you use? (1)

3.3.3 A bearing must be chosen to fit into a 19-mm diameter housing. The depth of the housing is 6 mm.

Which bearing (number) would you use? (1)

Principal dimensions (mm)	Basic load ratings		Bearing number
	Dynamic	Static	
d D B	C	C <sub>0</sub>	
3 10 4	488	146	623
4 12 4	806	280	604
6 19 6	1 720	620	626
9 26 8	4 620	1 960	629



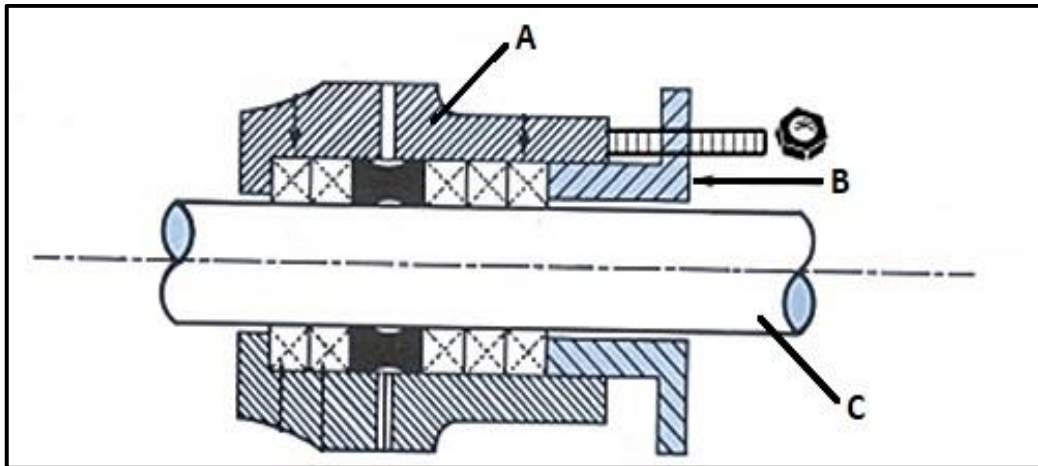
[10]



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

4.1 FIGURE 2 below shows a stuffing box with soft packing (asbestos).

Name the parts indicated on the sketch by writing only the answer next to the letter (A–C) in the ANSWER BOOK.



**FIGURE 2**

(3)

4.2 State FIVE reasons why industrial oil must be filtered.

(5)

4.3 Name TWO types of water-cooling systems.

(2)

4.4 State TWO reasons why gearboxes should be lubricated

(2)

4.5 Indicate whether the following statements are TRUE or FALSE. Write only 'True' or 'False' next to the question number (4.5.1 – 4.5.3) in the ANSWER BOOK.



4.5.1 Dry sump lubrication is used mainly in heavy and large engine vehicles.

4.5.2 Dry sump lubrication is non-efficient.

4.5.3 With the splash lubrication method, the crank shaft drives the lubrication process.



(3 x 1)

(3)

[15]

**QUESTION 5: HYDRAULICS AND PNEUMATICS**

5.1 Describe the functions of the following basic components in a pneumatic system:

5.1.1 Compressor



5.1.2 Actuator

5.1.3 Air service unit

(3 × 2) (6)

5.2 Calculate the force exerted by the plunger of fluid displaced by a plunger (in kilo-newton) with a diameter of 280 mm exerting a pressure of 435 kPa.

(4)  
[10]

**QUESTION 6: INTERNAL COMBUSTION ENGINE**

Choose a description from COLUMN B that matches a statement in COLUMN A. Write only the letter (A – D) next to the question number (6.1 – 6.3) in the ANSWER BOOK.



COLUMN A		COLUMN B	
6.1	Spark-ignition engine	A	induction phase of a two-stroke petrol engine
6.2	Two-stroke compression engine	B	exhaust phase of a two-stroke petrol engine
6.3	The upward movement of the piston causes a vacuum in the sump	C	another name for the two-stroke diesel engine
		D	another name for the two-stroke petrol engine

(3 × 2) [6]

**QUESTION 7: CRANES AND LIFTING MACHINES**

7.1 State THREE advantages of a load limiter.

(3)

7.2 State TWO advantages that result from increasing the number of drops in a steel rope.

(2)

7.3 Briefly explain the purpose of a crane.

(2)

[7]



**QUESTION 8: MATERIALS AND MATERIAL PROCESSES**

- 8.1 Choose a colour from COLUMN B that matches a metal in COLUMN A. Write only the letter (A–E) next to the question number (8.1.1–8.1.4) in the ANSWER BOOK.



COLUMN A		COLUMN B	
8.1.1	Low alloy steel	A	orange
8.1.2	Cast steel	B	brown
8.1.3	Low carbon steel	C	light purple
8.1.4	High carbon steel	D	blue
		E	black



(4 × 1)

(4)

- 8.2 Refer to the table below and give the missing characteristics of the different polymers. Write only the answer next to the question number (8.2.1 – 8.2.4) in the ANSWER BOOK.

Material	Touch	Sound	Hardness	Flame colour	Odour when burned
Poly-ethylene	8.2.1	Dull when dropped	Fairly soft and flexible	Blue with yellow tip	Candle
Poly-propylene	Waxy	8.2.2	Hard and stiff	Blue with yellow tip	Paraffin and candle
Polyvinyl-chloride	Soft and rubbery/ smooth	8.2.3	Soft and flexible/hard and stiff	Yellow white in flame	Acrid, chlorine
Polystyrene	Smooth	Metallic	Rigid	Bright yellow with sooty flakes	8.2.4



(4)

[8]



**QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING**

- 9.1 Name TWO classified factors to consider when intending to increase productivity in an organisation. (2)
- 9.2 State the basic purposes of a budget in an organisation. (2)
- 9.3 Briefly describe the purpose of each of the following documents:
  - 9.3.1 Clock cards
  - 9.3.2 Production flow charts
  - 9.3.3 Job cards
  - 9.3.4 Requisition cards



(4 x 2) (8)  
**[12]**



**QUESTION 10: ENTREPRENEURSHIP**

- 10.1 Explain the concept *small business enterprise*. (4)
- 10.2 State FOUR daily activities that can help an entrepreneur to generate business ideas. (4)

**[8]**

**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	-	-

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## 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 ( $\perp h$ )