



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANOTECHNOLOGY N3

(8190373)

8 February 2022 (X-paper)
09:00–12:00

Nonprogrammable calculators may be used.

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

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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. Only use a black or blue pen.
 6. Write neatly and legibly.
-

QUESTION 1: POWER TRANSMISSION, CLUTCHES AND COUPLING OF SHAFTS

- 1.1 A blower rotating at a speed of 700 r/min is driven by a 35-kW electric motor, rotating at 1 300 r/min. This is a medium-duty operation that functions for 11 hours per day. The blower operates through a soft start.

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

- 1.1.1 Calculate the speed ratio.
- 1.1.2 Determine the service factor for this drive.
- 1.1.3 Calculate the design power.
- 1.1.4 Determine the minimum pulley diameter.
- 1.1.5 Calculate the number of belts if the corrected power per belt is 20,89 kW. (5 × 2) (10)
- 1.2 Name the THREE sprocket wheels that could be distinguished with regard to a chain drive. (3)
- 1.3 State TWO advantages of the use of a centrifugal clutch as a coupling device between two shafts. (2)
- 1.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.
- 1.4.1 The addendum of a gear tooth is the radial height of the tooth below the circular pitch.
- 1.4.2 The V-belt has more reinforcement materials to make it stronger when compared to the wedge belt.
- 1.4.3 In gear drives Tooth thickness = Addendum + Dedendum
- 1.4.4 A spiral claw clutch can be used to transmit energy from one shaft to another, with the rotation taking place in both directions.
- 1.4.5 The module of a gear is the ratio between the circular pitch and the number of teeth on the gear and is measured in millimetres. (5 × 1) (5)
- [20]**


QUESTION 2: BRAKES



Give FIVE disadvantages of a cone brake system.

[5]

QUESTION 3: BEARINGS

3.1 State THREE advantages of guide bearings.  (3)

3.2 Name FOUR types of rolling elements applicable in antifriction bearings. (4)

3.3 Refer to FIGURE 1 (below) of a single-row radial cylindrical roller bearing and label the different parts (A–C), as indicated. Write only the answers next to the letter (A–C) in the ANSWER BOOK.

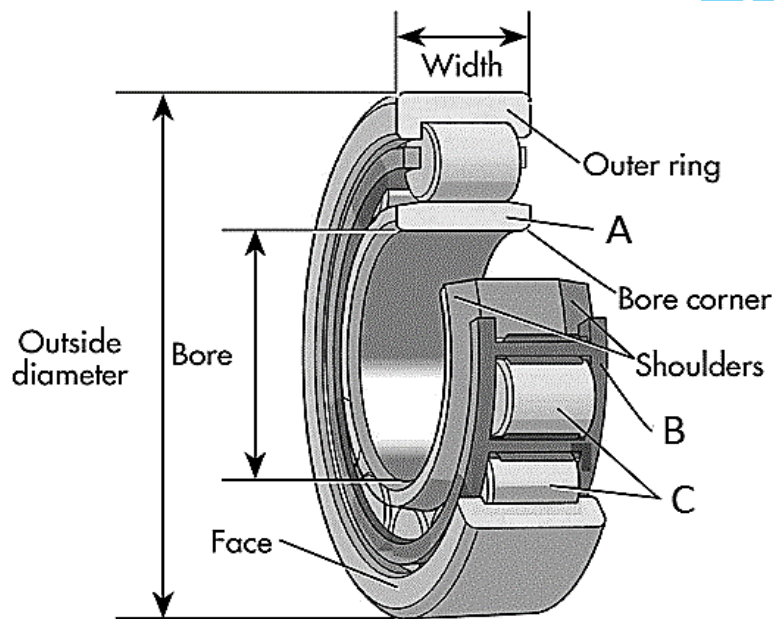


FIGURE 1



(3)
[10]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–P) next to the question number (4.1–4.15) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1	Transports fluids from one location to another	A	lubrication
4.2	Caused by the sudden closing of a valve	B	force pumps
4.3	Backward and forward movement developed from circular motion <input type="checkbox"/>	C	lubrication by mixing oil and petrol
4.4	Not suitable for pumping gases	D	overcooling of fuel
4.5	The difference between theoretical flow rate and real flow rate	E	plunger
4.6	Lift and push fluids from one level to the next	F	pump <input type="checkbox"/>
4.7	An element used to trap contaminants without restricting the flow oil	G	sight feed lubrication
4.8	If there are any leaks, you can see them immediately <input type="checkbox"/>	H	reciprocating action
4.9	Its length is longer than its stroke	I	centrifugal pumps
4.10	Method used to maximise the life span and endurance of a machine	J	pump slip
4.11	The water is stored in a radiator, where it is in turn cooled by air flow	K	water hammer
4.12	Mainly used in two-stroke petrol engines	L	external packing
4.13	The best cooling system for a stationary engine	M	indirect cooling
4.14	It results in the condensation of fuel	N	heat exchanger
4.15	The oil supply is controlled by the position of the needle	O	filter <input type="checkbox"/>
		P	direct cooling

(15 × 1)

[15]

QUESTION 5: HYDRAULICS AND PNEUMATICS

The diameter of a plunger in a hydraulic cylinder is 50 mm and the length of the cylinder is 150 mm. During operation, a pressure of 350 kPa is exerted on the plunger.

Calculate the following:

- 5.1 The cross-sectional area of the plunger (express answer in millimetres)
- 5.2 The force of the plunger (express answer in Newton)
- 5.3 The work done by the plunger, if it moved a distance of 80 mm (express answer in joules)

(3 x 2)

[6]

QUESTION 6: INTERNAL COMBUSTION ENGINE

Refer to FIGURE 2 (below) of a fuel injector and label the different parts (A–E), as indicated. Write only the answers next to the letter (A–E) in the ANSWER BOOK.

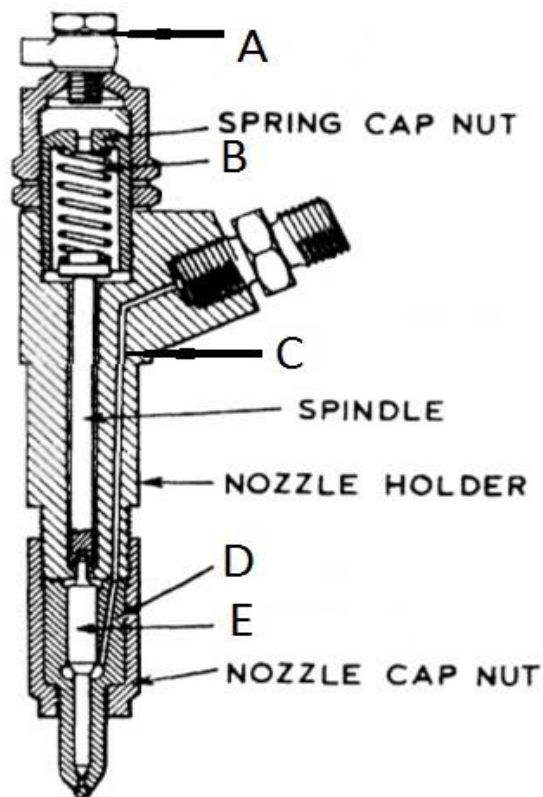
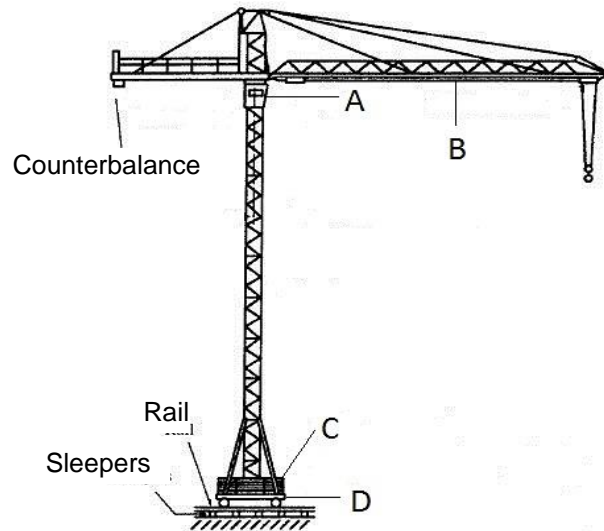


FIGURE 2

[5]

QUESTION 7: CRANES AND LIFTING MACHINES

- 7.1 State FOUR functions of a fibre core in a steel rope. (4)
- 7.2 Refer to FIGURE 3 (below) of a climbing-type tower crane (on a bogie) and label the different parts (A–D), as indicated. Write only the answers next to the letter (A–D) in the ANSWER BOOK.

**FIGURE 3**(4)
[8]**QUESTION 8: MATERIALS AND MATERIAL PROCESSES**

- 8.1 State FIVE characteristics of thermoplastics. (5)
- 8.2 Briefly explain the term *non-ferrous metal* and give an example. (2)
- 8.3 Metals are identified in the industry according to their colour codes. Give the identity colour codes for the following metals as standardised by the SABS:
- 8.3.1 Structural steel
- 8.3.2 Cast steel
- 8.3.3 High-carbon steel
- 8.3.4 Low-alloy steel
- 8.3.5 Stainless steel
- (5 × 1) (5)
- 8.4 State ONE result of normalising as a heat treatment process. (1)

[13]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

- 9.1 Name THREE types of verbal communication. (3)
 - 9.2 State FOUR reasons why a business/company should have a budget. (4)
 - 9.3 State FIVE reasons why a grievance should be submitted in writing. (5)
- [12]**

QUESTION 10: ENTREPRENEURSHIP

An entrepreneur needs certain resources to succeed.

Discuss the following resources:

- 10.1 Finance
- 10.2 Knowledge and skills
- 10.3 Contacts and friends

(3 × 2) [6]

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**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
500	67	90	100	112	125	140	180	200	212	236	250	280	280	315	375	400	450	475	500	560
600	67	85	90	100	112	125	140	180	200	212	224	250	265	280	300	335	375	400	475	500
720	67	80	85	90	90	106	132	150	160	170	200	236	250	265	280	300	335	375	450	500
960	67	75	80	85	95	100	112	132	150	180	180	200	224	250	280	280	300	335	400	450
1 200	67	71	80	80	95	95	106	118	132	150	160	180	200	236	236	250	265	300	335	355
1 440	67	67	75	80	85	85	100	112	125	140	160	170	190	212	236	236	250	280	315	335
1 800	67	67	71	75	80	85	95	106	112	125	150	160	170	190	212	224	236	265	300	335
2 800	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 ($\perp h$)*