



# higher education & training

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

## **NATIONAL CERTIFICATE MECHANOTECHNOLOGY N3**

(8190373)

**5 July 2022 (X-paper)  
09:00–12:00**

**Nonprogrammable calculators may be used.**

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

138Q1A2205

**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. Use only a black or a blue pen.
  6. Write neatly and legibly.
-

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

1.1 A centrifugal pump is sourced by an electric motor by means of a wedge belt.

The following information is available:



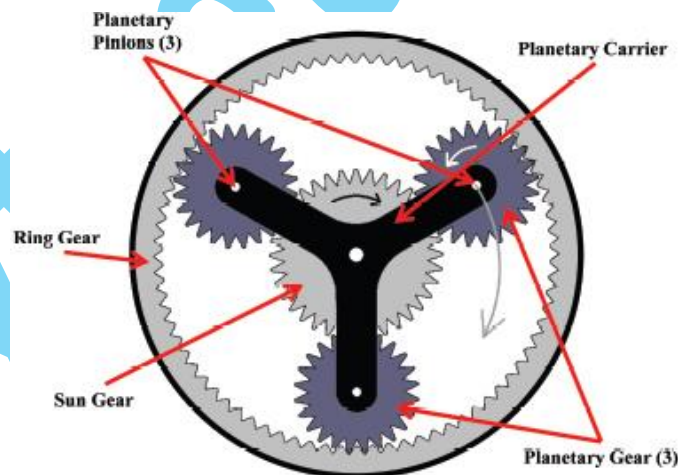
Wedge belt type	16 N
Power of the electric motor	55 kW
Speed of the pulley on the centrifugal pump	720 r/min
Basic power per belt	16,8 kW
Power increment	1,15 kW
Approximate centre distance	+/- 900 mm
Service factor	1,3
Correction factor	0,95
Pump speed ratio	1,2

Calculate:

- 1.1.1 The design power (2)
- 1.1.2 The speed of the electric motor (2)
- 1.1.3 The corrected power per belt (3)



1.2 Refer to FIGURE 1 below and answer the questions that follow:



**FIGURE 1**

- 1.2.1 Name the type of gear system shown. (1)
- 1.2.2 Name FOUR variations that can be obtained through the use of the gear system shown in FIGURE 1. (4)
- 1.3 Name THREE types of fast couplings applicable in the connection of shafts. (3)
- 1.4 State FIVE factors that determine the use of a friction clutch. (5)



**[20]**

## QUESTION 2: BRAKES

State FIVE disadvantages of a mechanical brake system.



[5]

## QUESTION 3: BEARINGS

3.1 The specific selection of bearings is largely dependent on certain basic factors

Provide FIVE of these factors.

(5)

3.2 The correct type and size of bearing can be selected with the aid of a manufacturer's catalogue. Refer to TABLE 3 below and determine the following:

Principal dimensions in millimetres			Basic load ratings in newtons		Bearing number
			Dynamic (N)	Static (N)	
d	D	B	C	C <sub>0</sub>	
4	12	4	806	280	604
3	10	4	488	146	623
6	19	6	1 720	620	626
9	25	8	4 620	1 960	629

TABLE 3

3.2.1 The nominal bore diameter of bearing number 604.

3.2.2 The bearing number for a bearing with a bore diameter of 9 mm to carry a dynamic load of 4 620 N.

3.2.3 The width of bearing number 626.



(1 × 3)

(3)  
[8]

## QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1 Define the following terms with regard to water flow:

4.1.1 Pump slip

(2)


4.1.2 Water hammer

(2)


4.1.3 Required head

(2)




- 4.2 Briefly describe the working principle of the following lubrication methods:
- 4.2.1 Siphon wick lubrication
  - 4.2.2 Splash lubrication 
  - 4.2.3 Force feed lubrication
- (2 × 3) (6)
- 4.3 State FOUR factors that cause overheating of engines. (4)
- [16]**

### QUESTION 5: HYDRAULICS AND PNEUMATICS

- 5.1 If a force of 1,5 kN is exerted on the small piston of a press, the piston will move down 130 mm. If the area of the small piston is 200 mm<sup>2</sup> and the area of the large piston is 2 m<sup>2</sup>, calculate:
-  5.1.1 The pressure in the system.
  - 5.1.2 The force exerted by the large piston.
  - 5.1.3 The diameter of the small piston, in millimetres
- (2 × 3) (6)
- 5.2 State the main difference between a hydraulic system and a pneumatic system. (2)
- [8]**

### QUESTION 6: INTERNAL COMBUSTION ENGINE

- 6.1 Describe the main function of an engine blower.  (3)
- 6.2 Briefly discuss *dead centre* as a term applicable in internal combustion engines. (2)
- [5]**

### QUESTION 7: CRANES AND LIFTING MACHINES

- 7.1 Lang's-lay refers to the method used when weaving a steel rope.
- Briefly state FOUR advantages of a Lang's-lay weaved steel rope in contrast with the cross-lay weaved steel rope. (4)

7.2 Refer to FIGURE 2 of a mobile crane with a telescopic jib and name the labelled parts by writing only the answer next to the letter (A–C) in the ANSWER BOOK.

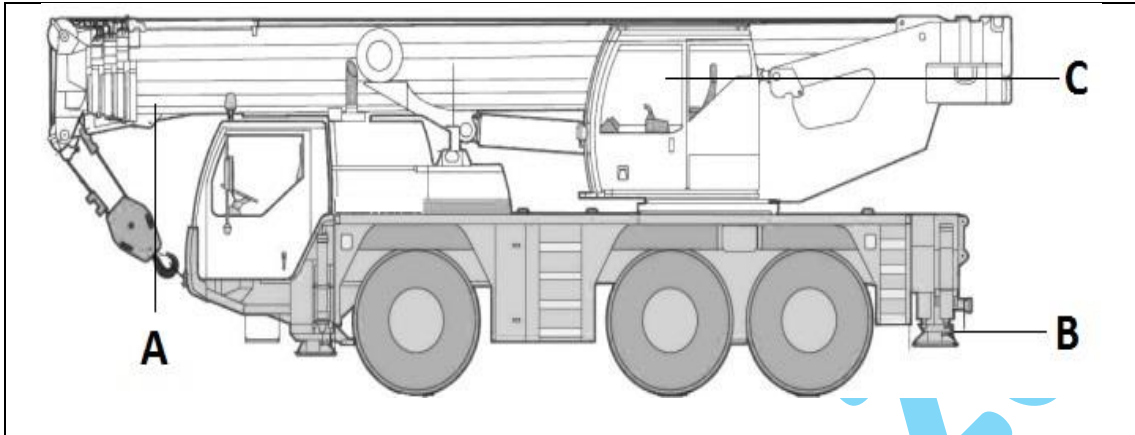


FIGURE 2

(3)

[7]

### QUESTION 8: MATERIAL AND MATERIAL PROCESSES

8.1 Explain what is meant by the following terms as properties of metal:

8.1.1 Malleability



8.1.2 Elasticity

8.1.3 Tensile strength

8.1.4 Ductility

(2 × 4)

(8)

8.2 State FOUR results of annealing as a heat treatment process.

(4)

[12]

### QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1 A budget is a financial plan that shows the future income and expenses of a business/organisation.



Briefly state the basic purposes of a cash budget for a business.

(4)

9.2 Communication that flows downwards from management to subordinates is called downward communication.

State FOUR advantages of downward communication in an organisation.

(4)

9.3 Discuss the term, *productivity*, relating to labour efficiency.



(3)

[11]

## QUESTION 10: ENTREPRENEURSHIP

10.1 In order to assist an entrepreneur, certain questions can be asked to get clarity on the correct location for a business.

State FIVE of these questions.



(5)

10.2 Discuss the significance of entrepreneurs in South Africa. Indicate three important points

(3)

[8]

**TOTAL:**

**100**

mytvet.co.za

**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
<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. *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 ( $\perp h$ )*

mytvet.co.za