



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANOTECHNOLOGY N3

(8190373)

12 November 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages, 2 tables and 1 formula sheet.

071Q1E2012

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. Write neatly and legibly.
-

QUESTION 1: POWER TRANSMISSION, CLUTCHES

- 1.1 A wedge belt drive is to be installed between an electric motor and a compressor with the following information:

| | |
|-------------------------|-------------|
| Type of wedge belt | 22 N SPN |
| Power of electric motor | 12 kW |
| Speed of smaller pulley | 1 300 r/min |
| Speed of larger pulley | 500 r/min |
| Type of start | heavy |
| Duty operational type | medium |
| Duty hours per day | 9 hours |

Refer to TABLE 1 and TABLE 2 to answer the following questions:


- 1.1.1 Calculate the speed ratio (3)
- 1.1.2 Calculate the design power (2)
- 1.1.3 Determine the minimum pulley diameter of the drive and indicate how the answer was obtained. (2)
- 1.2 State THREE main components of a centrifugal clutch. (3)
- 1.3 Name FOUR variations obtainable when using a planet gear system. (4)
- 1.4 Name THREE differences between a *belt drive* and a *chain drive*. (6)

[20]


QUESTION 2: BRAKES

- 2.1 State FOUR advantages of an air-brake system. **[4]**


QUESTION 3: BEARINGS

- 3.1 Give the meaning of each of the following figures with respect to anti-friction bearing identity numbers:
- 3.1.1 First figure 
- 3.1.2 Second figure
- 3.1.3 Third figure (3 × 1) (3)
- 3.2 Which THREE methods can be applied to examine the condition of a bearing? (3)
- 3.3 State FOUR main causes of vibration and noise which can be harmful in anti-friction bearings. (4)
- [10]**

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

- 4.1 State FOUR causes of overheating in cooling systems. (4)
- 4.2 State FOUR reasons for the cooling of compressors. (4)
- 4.3 Explain the purpose of lubrication.  (3)
- 4.4 State the difference between a *plunger* and a *piston* in water pumps. (2)
- [13]**

QUESTION 5: HYDRAULICS AND PNEUMATICS

- 5.1 A force is applied on piston A of a hydraulic press causing a force of 800 N on ram B. The distance moved by ram B is 9 mm upwards. The area of piston A is 2000 mm² and the area of ram B is 0,02 m².
- Calculate each of the following:
- 5.1.1 Diameter of ram B in mm (Round off your answer into 3 decimal places) (2)
- 5.1.2 Force (in N) applied on piston A  (3)
- 5.1.3 Distance in mm that piston A moves downwards (3)
- 5.2 State the characteristics of air flow with respect to area and flow rate in a pneumatic system. (3)
- [11]**

QUESTION 6: INTERNAL COMBUSTION ENGINES

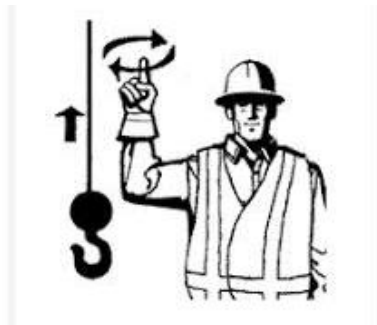
Redraw the table below and complete it by indicating THREE main construction differences between a petrol engine and a diesel engine.

| | PETROL | DIESEL |
|-----|--------|--------|
| 6.1 | | |
| 6.2 | | |
| 6.3 | | |


(3 × 2)

[6]**QUESTION 7: CRANES AND LIFTING MACHINES**


- 7.1 State TWO advantages of increasing the number of drops when hoisting loads with a steel rope. (2)
- 7.2 Name TWO methods of weaving steel ropes. (2)
- 7.3 Explain the purpose of a crane with respect to mechanical advantage. (2)
- 7.4 State TWO advantages of a load limiter when using steel ropes. (2)
- 7.5 What does the hand signal below indicate?

(1)
[9]

QUESTION 8: MATERIAL AND MATERIAL PROCESSES

- 8.1 Differentiate between the TWO main polymers. (4)
- 8.2 Briefly explain each of the following properties of metals:
- 8.2.1 Case hardening 
- 8.2.2 Normalising (2 × 2) (4)
- [8]**

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

- 9.1 State FOUR purposes of the Operational Health and Safety Act No.85 of 1993. (4)
- 9.2 Explain *budget control*. (2)
- 9.3 State the function of each of the following production control documents used when budgeting and controlling expenses in an industrial organisation:
-  9.3.1 Clock cards
- 9.3.2 Production flow charts
- 9.3.3 Job cards (3 × 2) (6)
- [12]**

QUESTION 10: ENTREPRENEURSHIP


- 10.1 Briefly explain *entrepreneurship*. (3)
- 10.2 Briefly explain the following techniques an entrepreneur can use to create something new:
- 10.2.1 Metaphorical analogy
- 10.2.2 Brainstorming  (2 × 2) (4)
- [7]**
- TOTAL: 100**

TABLE 1**SERVICE FACTORS FOR SELECTION OF WEDGE BELTS**

| TYPES OF DRIVEN MACHINES | TYPES OF PRIME MOVERS | | | | | |
|---|-----------------------|---------------|---------|--------------------|---------------|---------|
| | Soft starts | | | Heavy starts | | |
| | Duty hours per day | | | Duty hours per day | | |
| | 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 | - | - |

MECHANOTECHNOLOGY N3

FORMULA SHEET

Any other 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 ($\perp h$)*