



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANOTECHNOLOGY N3

(8190373)

7 April 2020 (X-paper)
09:00–12:00

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

138Q1A2007

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. Write neatly and legibly.
-

QUESTION 1: POWER TRANSMISSION; COUPLING OF SHAFTS; CLUTCHES

1.1 The following information is applicable to a gear drive:

- Power transmitted = 4 500 W
- Speed of the shaft = 2 800 r/min



Calculate the torque on the shaft.

(3)

1.2 Modern workshops prefer to join a number of shorter shafts through the use of couplings to obtain the required length.

State TWO reasons for joining shorter shafts in contrast of using longer ones.

(2)

1.3 1.3.1. Label the parts indicated in FIGURE 1 by writing only the answer next to the letter (A–B) in the ANSWER BOOK.

FIGURE 1 is a cross-section of a shaft coupling. It shows two shafts joined by a coupling. The coupling has a central body with internal threads and a flange on one end. The shafts are inserted into the coupling and secured with bolts. The coupling is shown in a perspective view.

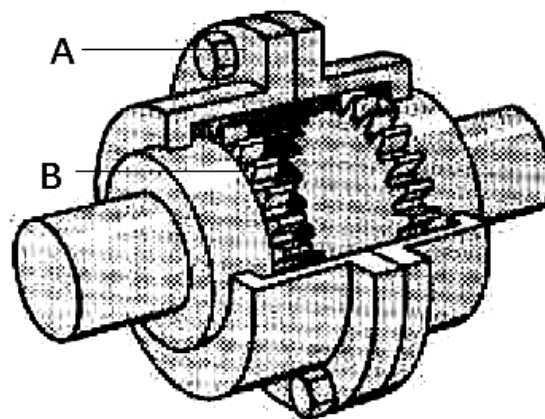


FIGURE 1

(2)

1.3.2. Speed ratio

(1)

1.4 Flexible tyre couplings are available in a combination of different substances.

Name TWO of these substances.



(2)

1.5 State FIVE qualities that the hydraulic oil of the clutch should have.

(5)

1.6 Demonstrate the following factors with a clearly written formula:

1.6.1 Speed ratio



1.6.2 Number of belts

1.6.3 Belt length

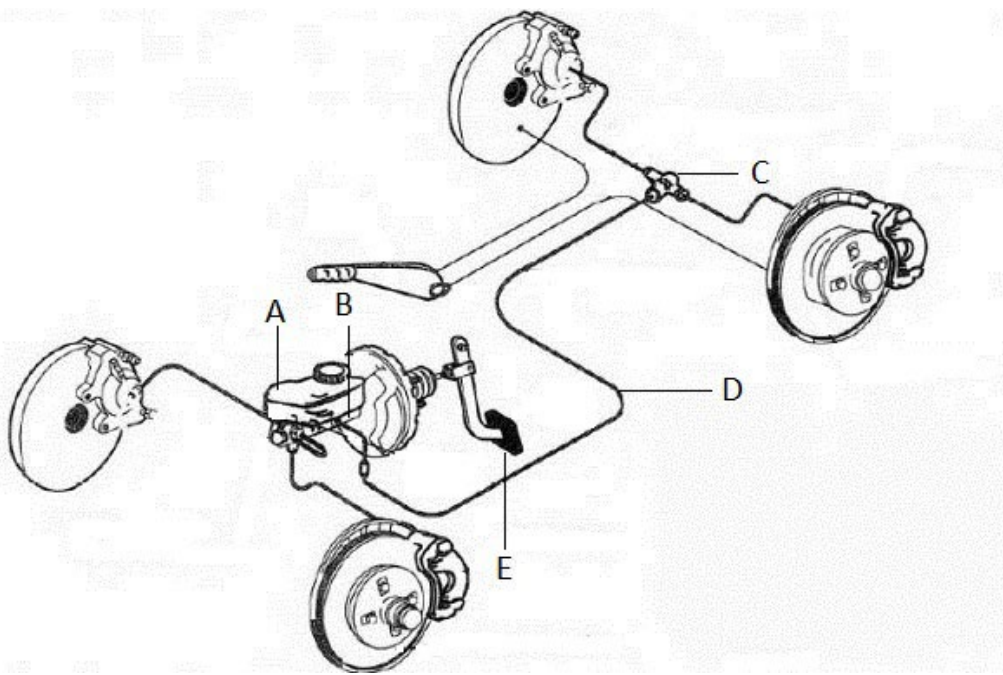
(3 × 2)

(6)

[21]

QUESTION 2: BRAKES

FIGURE 2 shows the layout of a hydraulic brake system. Name the parts indicated in the sketch by writing only the answer next to the letter (A–E) in the ANSWER BOOK.

**FIGURE 2****[5]****QUESTION 3: BEARINGS**

- 3.1 Antifriction bearings operate on the principle of rolling motion and are therefore also called rolling bearings.

Name FOUR rolling elements commonly used in antifriction bearings.

(4)

- 3.2 State SIX factors to consider when selecting the correct type and size of bearing when using a manufacturer's catalogue.

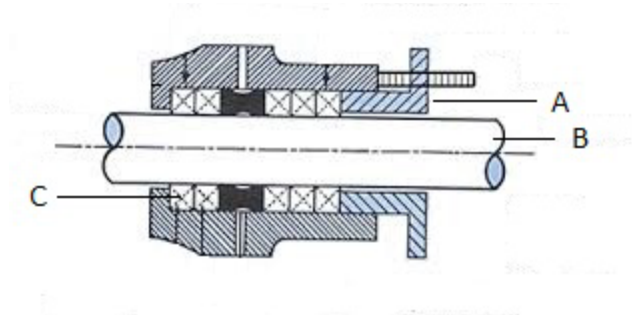
**(6)
[10]**

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

- 4.1 4.1.1 Name the parts indicated in the sketch in FIGURE 3 below by writing only the answer next to the letter (A–C) in the ANSWER BOOK. (3)



- 4.1.2 Name the device shown in FIGURE 3. (1)

**FIGURE 3**

- 4.2 Briefly explain the purpose of a mechanical seal. (1)

- 4.3 Define an *oil filter*. (2)



- 4.4 State in THREE points why lubrication oil should be properly filtered. (3)

- 4.5 Two commonly known water cooling systems are thermosyphon and impeller-assisted cooling systems.

State FOUR disadvantages of the *thermosyphon cooling system* over the *impeller assisted cooling system*.

(4)
[14]

QUESTION 5: HYDRAULICS

- 5.1 A force applied on piston A causes a force of 1 kN on Ram B in a hydraulic press. Ram B moves 10 mm upwards. The area of piston A is 0,02 m² and the area of Ram B is 0,18 m².

Calculate the following:



- 5.1.1 The diameter of Ram B
- 5.1.2 The force applied on piston A
- 5.1.3 The distance that piston A moves downwards in mm (3 × 2) (6)

- 5.2 State FIVE functions of a hydraulic fluid in a hydraulic system. (5)



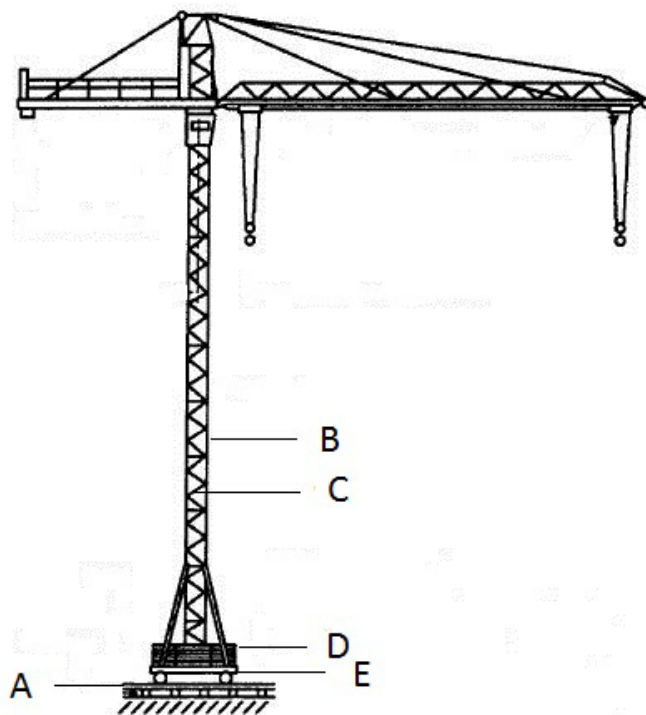
[11]

QUESTION 6: INTERNAL COMBUSTION ENGINE

- 6.1 State FOUR disadvantages of a *diesel engine* when compared to a *petrol engine*. (4)
- 6.2 State TWO functions of the carburettor of a petrol engine. (2)
- [6]**


QUESTION 7: CRANES AND LIFTING MACHINES

- 7.1 A tower crane on a bogie is shown in FIGURE 4. Name the parts indicated in the sketch by writing only the answer next to the letter (A–E) in the ANSWER BOOK.


**FIGURE 4**

- 7.2 State TWO responsibilities and/or characteristics to consider during the selection and application of steel ropes. (2)
- [7]**

QUESTION 8: MATERIAL AND MATERIAL PROCESSES

- 8.1 State the purpose of the following heat treatment processes on metals:
- 8.1.1 Tempering  (2)
- 8.1.2 Hardening (2)
- 8.2 Describe the term *heat treatment process*. (3)
- [7]**

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

- 9.1 Briefly discuss organisational communication with respect to the following communication channels:
- 9.1.1 Downward communication
- 9.1.2 Upward communication
-  9.1.3 Horizontal communication
- 9.1.4 Diagonal communication (4 × 2) (8)
- 9.2 Explain *capital budget*. (3)
- [11]**

QUESTION 10: ENTREPRENEURSHIP

Briefly discuss the following qualities of an entrepreneur:

- 10.1 Drive and energy
- 10.2 Persistence 
- 10.3 Responsibility
- 10.4 Self-confidence (4 × 2) **[8]**
- TOTAL: 100**

TABLE 1**SERVICE FACTORS FOR THE SELECTION OF WEDGE BOLTS**

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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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 ($\perp h$)*