higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1130(**E**)(A5)T

NATIONAL CERTIFICATE

MECHANOTECHNOLOGY N3

(8190373)

5 April 2018 (X-Paper)
09:00–12:00

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

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.   Use a BLACK or BLUE pen.

5.   Start each section on a NEW page.

6.   Write neatly and legibly.

QUESTION 1: BELTS AND CHAIN DRIVES

1.1   A wedge belt is fitted between an electric motor and an air compressor. The operation is medium drive, over a period of 8 hours. The electric power of the motor is 20 kW.

The following information is also provided:
Correction factor   0,98
Corrected power per belt   22 kW
Power increment (additional power) per belt   2,5 kW
Type of start   soft

Calculate each of the following:

1.1.1   The basic power per belt   (3)

1.1.2   The number of belts for the drive   (4)

1.2   Explain the term *speed ratio* in relation to belt drives.   (2)

1.3   Describe the purpose of the *service factor*.   (2)

1.4   A gear drive produces 3 500 W at a shaft speed of 2 000 r/min.

Calculate the torque on the shaft.   (3)

1.5   Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.5.1–1.5.6) in the ANSWER BOOK.

1.5.1   One of the important features of couplings is that they provide a semi-permanent connection between two shafts.

1.5.2   Muff couplings are also known as steel-grid couplings.

1.5.3   The four categories of clutches are: positive, friction, reciprocating, and hydraulic clutches.

1.5.4   A centrifugal clutch uses circulating fluid.

1.5.5   The drive of a spiral claw clutch takes place in both directions.

1.5.6   One of the disadvantages of the centrifugal clutch is its 'shock' engagement operation.

                                                                  (6 × 1)   (6)
   **[20]**

QUESTION 2: BRAKES

2.1 Explain the operational principle of a mechanical brake system. (4)

2.2 State TWO disadvantages of cone brake systems. (2)

[6]

QUESTION 3: BEARINGS

3.1 Explain the working principle of a friction bearing. (2)

3.2 Name FOUR types of anti-friction bearings. (4)

3.3 All bearings have a life span, even when correctly designed, manufactured, installed and maintained.

State SIX conditions or factors that can cause a bearing to fail. (6)

[12]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1 Pumps use various methods to deliver fluids.

Briefly explain the term *reciprocating movement* with regard to water pumps. (2)

4.2 Refer to the plunger pump with internal packing in FIGURE 1 below and answer the question.
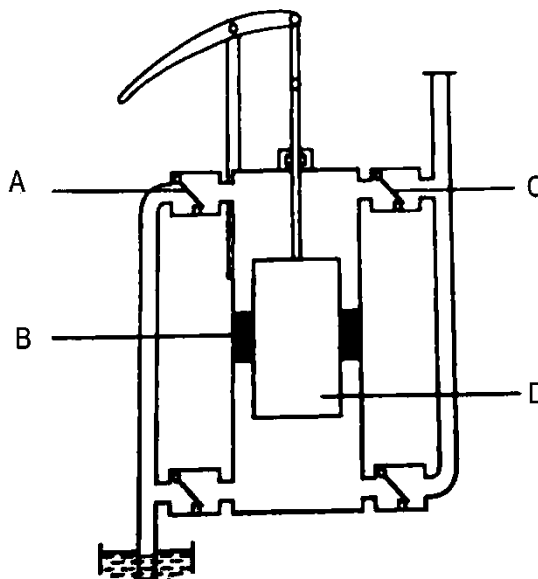
FIGURE 1

Label the parts marked A–D in the plunger pump in FIGURE 1. Write only the answer next to the letter (A–D) in the ANSWER BOOK. (4)

4.3 A plunger and a piston perform the same task in a reciprocating pump; however, they differ with regard to two features.

State these TWO main differences. (4)

4.4 As a cooling system, a compressor during its operation can generate intense heat.

Give THREE reasons why it is necessary for compressors to be cooled. (3)

[13]

QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1 A force is the source of 580 MPa inside a cylinder with a diameter of 155 mm. Use $\pi = 3{,}142$

Calculate the following:

5.1.1 The magnitude of the total force in the cylinder. Express the answer in kN.

5.1.2 The total volume displaced in THREE hydraulic hoses that are connected to the cylinder, if the plunger moves a distance of 65 mm.

(2 × 2) (4)

5.2 Hydraulic symbols are laid down by the International Organisation for Standardisation (ISO).

Make a neat drawing of each of the following symbols:
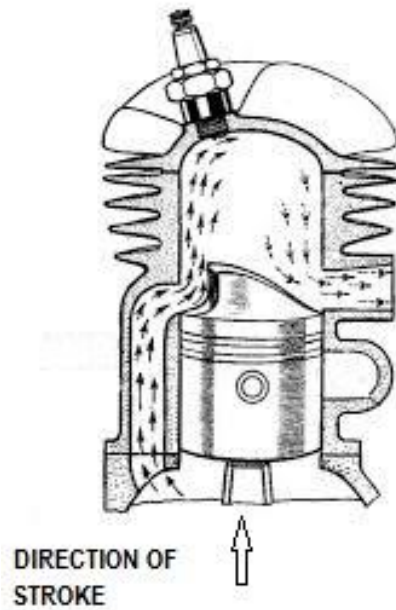
5.2.1 Adjustable flow control valve

5.2.2 4-port, 2-directional control valve

5.2.3 Hydraulic motor

(3 × 2) (6)

[10]

QUESTION 6: INTERNAL COMBUSTION ENGINES

6.1   Define the term *compression ratio*.   (2)

6.2   Refer to the two-stroke petrol engine in FIGURE 2 below and answer the question.

DIRECTION OF STROKE

FIGURE 2

Name the phase/s indicated in the two-stroke petrol engine in FIGURE 2.   (2)

6.3   Give ONE function of a turbo in the cylinder of a petrol or diesel engine.   (1)

[5]

QUESTION 7: CRANES AND LIFTING MACHINES

7.1   The table below shows possible faults on steel ropes as well as their possible causes. Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–E) next to the question number (7.1.1–7.1.4) in the ANSWER BOOK.

COLUMN A FAULT		COLUMN B POSSIBLE CAUSE
7.1.1 Corrosion	A	high bearing and contact pressure
7.1.2 Stretch	B	sudden release of rope
7.1.3 Accelerated wear	C	exposure to acids and alkali
7.1.4 Distortion of lay	D	rope incorrectly cut
	E	overload

(4 × 1)   (4)

7.2   Briefly state THREE advantages of a wharf crane.   (3)
                                                                                  [7]

QUESTION 8: MATERIAL AND MATERIAL PROCESSES

8.1   Give THREE reasons for the normalising of a metal as a heat treatment
        process.   (3)

8.2   When adding an alloy in various proportions of iron, specific properties of
        metal can be obtained.

        Name THREE of these specific properties of metal.   (3)
                                                                                  [6]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1   Name FOUR technological factors that will improve productivity in an
        organisation.   (4)

9.2   One of the channels of communication in an organisation is downward
        communication.

        Briefly describe FIVE limitations of this type of communication.   (5)

9.3   The cash budget is the projection of the future cash flow.

        Give THREE reasons for having a cash budget in a firm or company.   (3)
                                                                                  [12]

QUESTION 10: ENTREPRENEURSHIP

10.1   Discuss *brainstorming* as the entrepreneur's way of keeping up in terms of
        business improvement.   (3)

10.2   Name THREE general business resources that an entrepreneur must have in
        order to succeed in business.   (3)

10.3   Give THREE factors that an entrepreneur must consider when choosing a
        location for his/her business.   (3)
                                                                                  [9]

                                                           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	-	-

MECHANOTECHNOLOGY N3

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*