higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1130**(E)**(N22)T

NATIONAL CERTIFICATE

MECHANOTECHNOLOGY N3

(8190373)

22 November 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 pages, 1 formula sheet and 4 tables.

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

1.1 A 16 N SPB wedge belt is fitted between an electrical motor and a hammer mill.

Consider the following information when performing the necessary calculations:

Design power of the supplying electric motor	48 kW
Basic power per belt	22 kW
Power increment (additional power) per belt	1,90 kW
Type of start	'soft'
Duty operation type	'medium'
Operational hours per day	9 hours
Speed of the electric motor pulley	1 450 r/min
Service factor	1,2
Correction factor	0,85

Calculate the following:

1.1.1 The power supplied by the electric motor in kW. (2)

1.1.2 The corrected power per belt in kW. (3)

1.1.3 The number of belts (3)

1.2 A wedge belt is designed as an improvement of the V-belt.

State FOUR design aspects of a wedge belt that serve as improvement of the V-belt. (4)

1.3 Study FIGURE 1 below, showing the different components of a basic chain, and answer the question that follows:

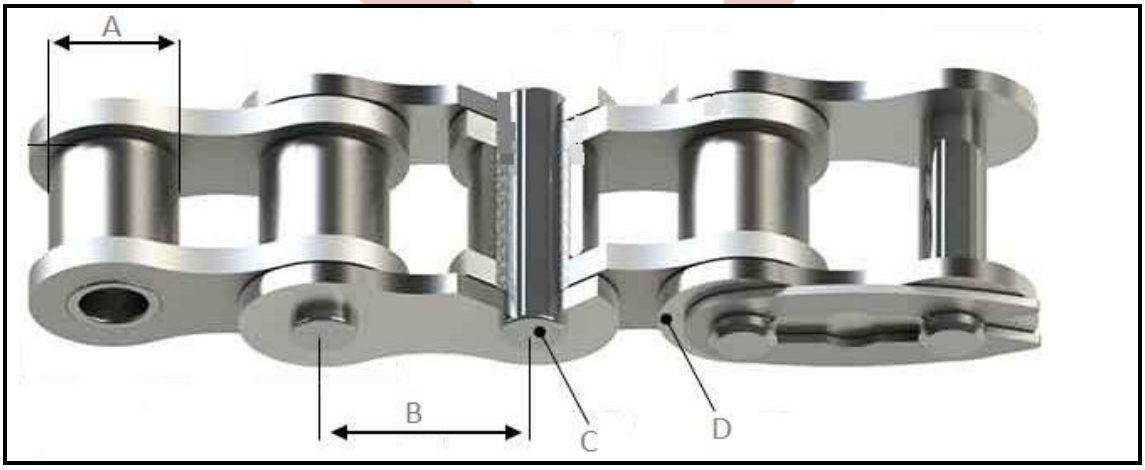

FIGURE 1

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

1.4 State FOUR advantages of a worm and worm wheel gear system. (4)

[20]

QUESTION 2: BRAKES

State FIVE disadvantages of a cone brake. **[5]**

QUESTION 3: BEARINGS

3.1 State FIVE factors that can cause a bearing to vibrate and make noise. (5)

3.2 State FOUR advantages of guide bearings. (4)

3.3 Give ONE disadvantage of guide bearings. (1)
[10]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1 Describe the *reciprocating movement* in reciprocating pumps. (2)

4.2 State THREE main moving elements found in a centrifugal pump. (3)

4.3 Discuss the working principle of a dry sump lubrication method. (3)

4.4 State FOUR reasons for cooling internal combustion engines. (4)

4.5 Explain the working principle of an indirect cooling system. (3)
[15]

QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1 State Pascal's law on fluid. (2)

5.2 A force is exerted on a fluid, causing a pressure of 550 MPa within a cylinder designed with a diameter of 160 mm.

Calculate the following:

5.2.1 The magnitude of the force in the cylinder. Express your answer in kN. (2)

5.2.2 The total volume occupied if the master cylinder is connected to three identical slave cylinders each with a 90 mm diameter piston and travelling a distance of 40 mm. (3)

5.3 The pressure relief valve, also known as a safety valve, is used to reduce air from the tank to maintain the minimum required pressure in the system.

Draw a reasonable symbol of a pressure relief valve. (2)

5.4 State ONE function of the actuator of a pneumatic systems (2)
[11]

QUESTION 6: INTERNAL COMBUSTION ENGINES

Refer to FIGURE 2 below, showing different strokes of a four-stroke petrol engine, and answer the question.

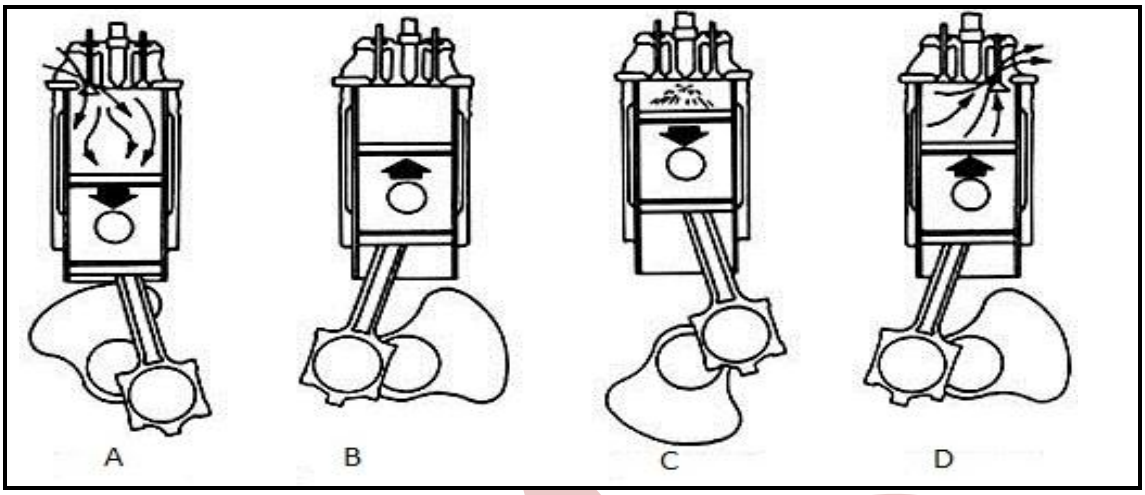

FIGURE 2

Name the different strokes A–D in FIGURE 2. Write the answer next to the letter (A–D) in the ANSWER BOOK.

[4]

QUESTION 7: CRANES AND LIFTING MACHINES

7.1 Refer to FIGURE 3 below, showing a sketch of a wharf crane, and answer the question.

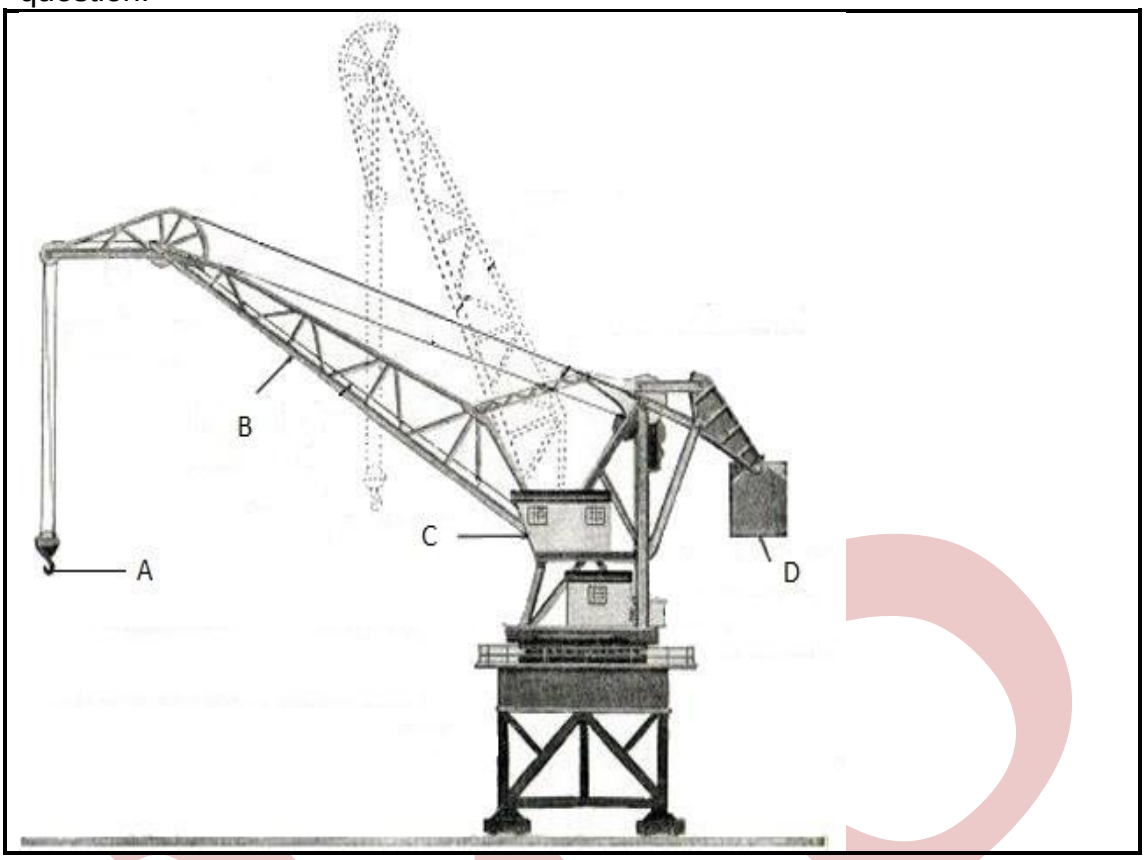

FIGURE 3

Label the different parts A–D in FIGURE 3. Write the answer next to the letter (A–D) in the ANSWER BOOK. (4)

7.2 State FOUR possible causes of accelerated wear in steel ropes. (4)
[8]

QUESTION 8: MATERIALS AND MATERIAL PROCESSES

8.1 Discuss the difference between hardening and normalising through heat treatment. (4)

8.2 State the difference between ferrous and non-ferrous metals. (2)

8.3 Name the colour code for each of the following metals

8.3.1. Structural steel (1)

8.3.2. Pipeline steel (1)
[8]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1 State FOUR channels that are generally used for downward communication. (4)

9.2 Briefly explain the purpose of the Labour Relations Act (No. 66 of 1995). (4)

9.3 State FOUR functions of a clock card in a workplace. (4)
[12]

QUESTION 10: ENTREPRENEURSHIP

10.1 Define an *entrepreneur.* (4)

10.2 Entrepreneurs play a key role in the development of the South African economy.

State THREE important roles played by entrepreneurs in South Africa. (3)
[7]

TOTAL: 100

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 height* $(\perp h)$

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

CENTRE DISTANCES FOR 16 N SPB WEDGE BELT DRIVES

Combined arc and belt length Correction factor					0,8			0,85			0,9				1.05			
Speed Ratio	Pitch diameter of pulleys		Power per belt kW		BELT LENGTH													
	Driver	Driven	960 r/min	1 440 r/min	1 260	1 340	1 410	1 590	1 800	1 900	2 020	2 150	2 280	2 400	4 560	4 820	5 070	5 380
1,69	236	400	11,94	16,56	-	-	-	-	392	443	504	570	635	696	1 779	1 909	2 034	2 189
1,75	160	280	6,45	8,92	278	319	355	446	551	602	662	727	792	852	-	-	-	-
1,75	180	315	7,92	11,00	-	273	309	401	507	557	618	683	748	809	-	-	-	-
1,78	200	355	9,38	13,03	-	-	-	351	458	508	569	635	700	760	1 843	1 973	2 098	-
1,79	140	250	4,95	6,80	319	360	395	486	591	641	702	767	832	892	-	-	-	-
1,79	224	400	11,10	15,41	-	-	-	-	400	452	513	578	644	705	1 788	1 918	2 043	2 198

Please turn over

TABLE 3

CENTRE DISTANCES FOR 22 N SPC WEDGE BELT DRIVES

Combined arc and belt length Correction factor					0,80			0,85			0,90					0,95		
Speed Ratio	Pitch diameter of pulleys		Power per belt kW		BELT LENGTH													
	Driver	Driven	960 r/min	1 440 r/min	2 000	2 120	2 240	2 360	2 500	2 650	2 800	3 000	3 150	3 350	3 550	3 750	4 000	4 250
1,58	400	630	37,85	49,15	-	-	-	-	-	-	580	682	758	859	960	1 060	1 186	1 311
1,58	300	475	25,19	33,63	-	443	504	565	636	711	787	887	963	1 063	1 163	1 264	1 389	1 514
1,58	224	355	14,82	19,80	542	602	662	723	793	868	943	1 043	1 119	1 219	1 319	1 419	1 544	1 669
1,59	315	500	27,16	36,17	-	-	471	532	603	679	755	855	931	1 031	1 131	1 232	1 357	1 482
1,59	236	375	16,50	22,09	516	576	637	697	767	842	918	1 018	1093	1 193	1 293	1 394	1 519	1 644
1,60	250	400	18,44	24,71	484	545	605	666	736	811	887	987	1 062	1 162	1 263	1 363	1 488	1 613
1,60	500	800	49,26	-	-	-	-	-	-	-	-	-	-	-	739	841	968	1 094

Please turn over

TABLE 4

MINIMUM PULLEY DIAMETER (mm)

Speed of faster shaft r/min	Minimum pulley diameter (mm)																		
	Design Power (kW)																		
	Up 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	-	-