higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

T1130**(E)**(A2)T

NATIONAL CERTIFICATE

MECHANOTECHNOLOGY N3

(8190373)

2 August 2019 (X-Paper)
09:00–12:00

This question paper consists of 6 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; CLUTCHES; COUPLING OF SHAFTS

1.1 A 16 N SPN wedge belt operates between a compressor and a 15 kW electric motor with a speed ratio of 1,8:1. The speed of the compressor pulley is 700 r/min and that of the electric motor is 1 440 r/min. The approximate centre distance between the drives is ±760 mm. The service factor is 1,1.

Refer to the attached TABLES and answer the questions.

1.1.1 Determine the pulley pitch diameters. (1)

1.1.2 Calculate the belt length. (2)

1.1.3 Determine the correction factor. (1)

1.1.4 Calculate the design power. (2)

1.2 Explain the purpose of each of the following aspects in belt drives:

1.2.1 Service factor

1.2.2 Idler pulley

(2 × 1) (2)

1.3 Explain *belt deflection*. (1)

1.4 Name FOUR main clutch categories. (4)

1.5 State FIVE advantages of a hydraulic clutch. (5)

1.6 Name TWO examples of permanent couplings. (2)

[20]

QUESTION 2: BRAKES

List FIVE disadvantages of an internal drum and shoe brake system. **[5]**

QUESTION 3: BEARINGS

3.1 FIGURE 1 shows an antifriction bearing.

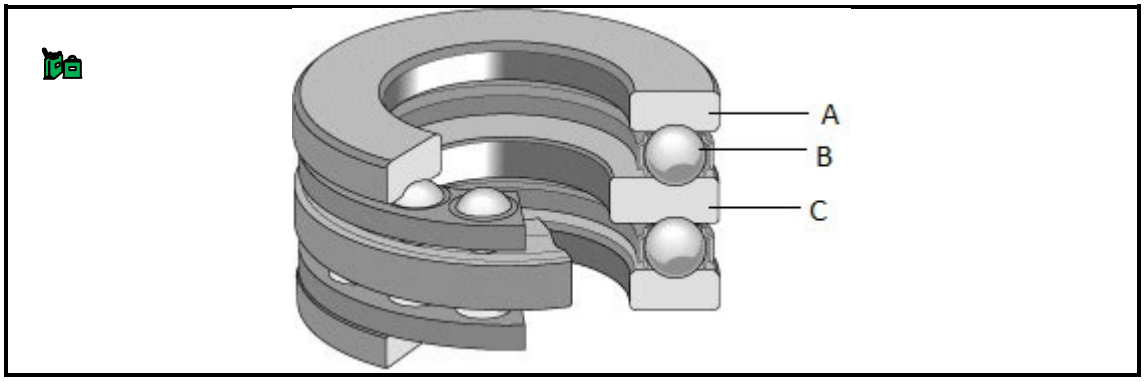

FIGURE 1

3.1.1 Name the bearing. (1)

3.1.2 State the type of load handled by the bearing. (1)

3.1.3 Identify the indicated parts of the bearing by writing the answers next to the letter (A–C) in the ANSWER BOOK. (3)

3.2 State FIVE factors to consider when choosing an antifriction bearing. (5)

[10]

QUESTION 4: COOLING AND LUBRICATION

4.1 Give FIVE reasons for the lubrication of internal combustion engines. (5)

4.2 Discuss the difference between *direct* and *indirect air cooling.* (5)

4.3 State FOUR advantages of the impeller-assisted cooling system over the thermo syphon cooling system. (4)

[14]

QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1 A force exerted on a cylinder develops an internal pressure of 680 kPa inside the cylinder with a diameter of 200 mm.

Calculate each of the following:

5.1.1 The magnitude of the force exerted on the cylinder in kN

5.1.2 The total volume developed if THREE hydraulic cylinders are used. Take the distance moved by the plunger to be 50 mm.

(2 × 3) (6)

5.2 State TWO types of pressure acting on fluid. (2)

5.3 Name THREE categories under which hydraulic valves are classified. (3)

5.4 Make a sketch of reasonable size of an hydraulic adjustable flow-control valve. (2)

[13]

QUESTION 6: INTERNAL COMBUSTION ENGINES

FIGURE 2 shows a component found in a combustion engine.

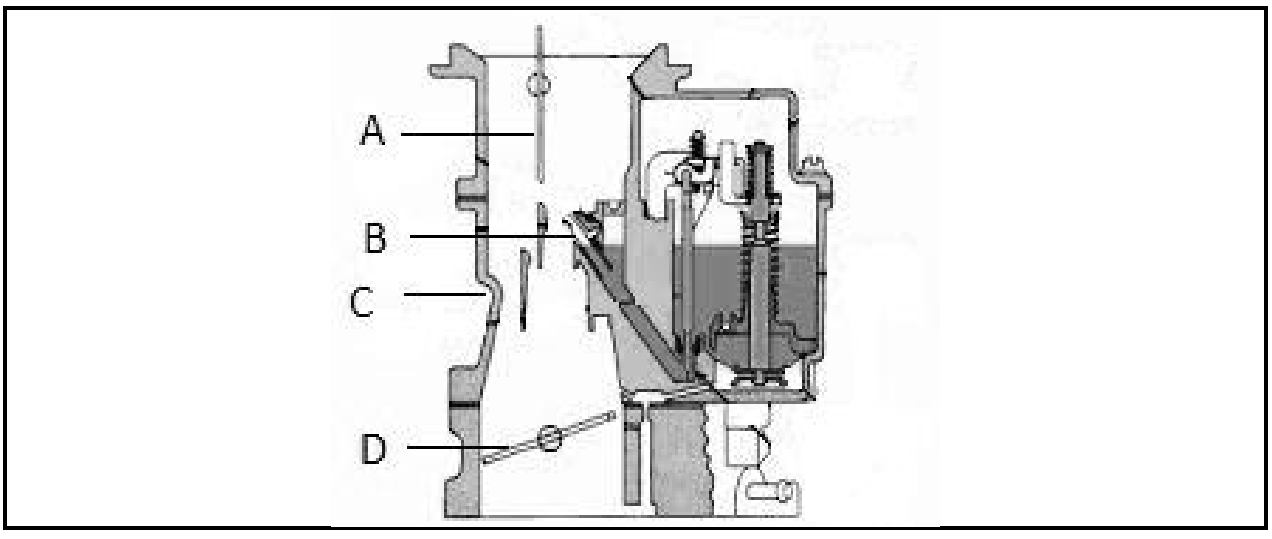

FIGURE 2

6.1 Name the component. (1)

6.2 Name the indicated parts of the component by writing the answer next to the letter (A–D) in the ANSWER BOOK. (4)

[5]

QUESTION 7: CRANES AND LIFTING MACHINES

7.1 State FOUR factors to consider when choosing a steel rope. (4)

7.2 Explain each of the following movements of a multipurpose crane:

7.2.1 Swivel motion

7.2.2 Long travel motion

(2 × 2) (4)
[8]

QUESTION 8: MATERIALS AND MATERIAL PROCESSESS

8.1 State the difference between *thermoplastics* and *thermosetting plastics*. (2)

8.2 Name THREE properties that can be obtained through the heat treatment process. (3)
[5]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1 Discuss the purpose of requisition cards in a workplace. (3)

9.2 Efficiency is necessary to sustain production.

State SIX technological factors that help increase productivity in a workplace. (6)

9.3 State THREE limitations of downward communication. (3)
[12]

QUESTION 10: ENTREPRENEURSHIP

10.1 Explain *entrepreneurship* (3)

10.2 State FIVE guidelines to follow when brainstorming for ideas. (5)
[8]

TOTAL: 100

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* $(\perp h)$

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

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	-	-