



# higher education & training

---

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

T1130(E)(A4)T

**NATIONAL CERTIFICATE**

**MECHANOTECHNOLOGY N3**

(8190373)

**4 April 2019 (X-Paper)**

**09:00–12:00**

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

**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.
-

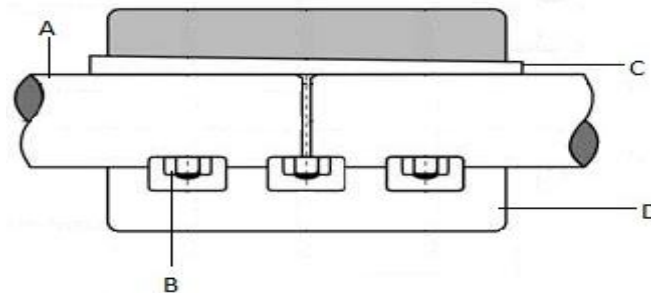
**QUESTION 1: POWER TRANSMISSION, CLUTCHES AND COUPLING OF SHAFT**

- 1.1 A car wash machine, rotating at 800 r/min, is driven by a 38 kW electric motor with a rotational speed of 1200 r/min. It operates at medium duty for only eleven hours per day and a soft start is used.



Answer the questions below, using the attached tables.

- 1.1.1 Calculate the speed ratio. (1)
- 1.1.2 Determine the service factor. (1)
- 1.1.3 Calculate the design power. (2)
- 1.1.4 Determine the minimum pulley diameter. (1)
- 1.1.5 Calculate the number of belts if the corrected power per belt is 22 kW. (2)
- 1.2 State THREE factors to consider before deciding to apply a transmission of gear drives. (3)
- 1.3 Study FIGURE 1 below which shows a coupling and answer the questions.



**FIGURE 1**

- 1.3.1 Name the type of coupling. (1)
- 1.3.2 Label parts A–D by writing the answer next to the letter (A–D) in the ANSWER BOOK. (4)
- 1.4 Briefly describe the purpose of a clutch. (2)
- 1.5 State THREE advantages of operating a loose-weight centrifugal clutch. (3)



**[20]**

**QUESTION 2: BRAKES**

Discuss the operating principle of air brakes.

[6]

**QUESTION 3: BEARINGS**

3.1 Distinguish between *friction bearings* and *antifriction bearings*. (2)

3.2 Antifriction bearings must be free of contamination and must be monitored regularly.

State THREE methods to determine the condition of a bearing during service. (3)

3.3 Indicate whether the following statement is TRUE or FALSE. Write only 'True' or 'False' next to the question number (3.3.1.) in the ANSWER BOOK.

3.3.1. Each bearing has an identification number consisting of three figures, the third figure refers to its diameter series.



(1)  
[6]

**QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION**

4.1 If you experience a problem with a centrifugal pump, it will usually be at the suction side of the pump

Briefly explain how can you overcome this problems (2)

4.2 Explain the function of a petcock in a centrifugal pump. (2)

4.3 Name ONE purpose of a mechanical seal in water pumps. (1)

4.4 State FOUR advantages of an impeller-assisted cooling system over a thermosyphon cooling system. (4)



4.5 Discuss the working principle of a heat-exchanger as a water cooling system. (3)

4.6 FIGURE 2 shows a splash lubrication setup.

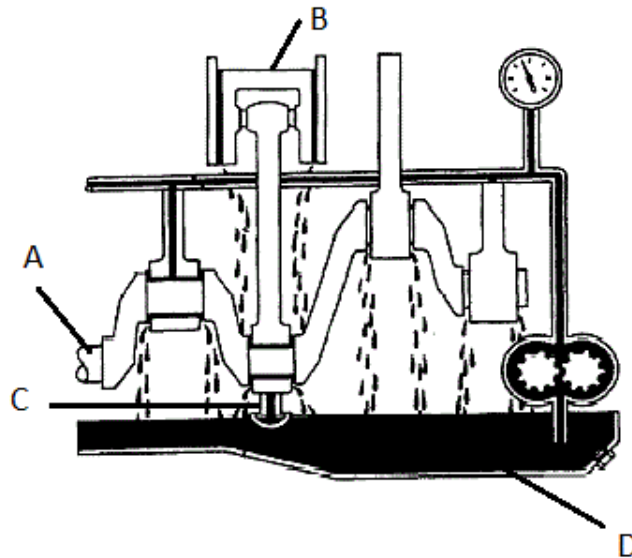


FIGURE 2

Label the marked parts by writing the answer next to the letter (A–D) in the ANSWER BOOK.

(4)  
[16]

**QUESTION 5: HYDRAULICS AND PNEUMATICS**

5.1 State THREE functions of a hydraulic accumulator. (3)

5.2 Draw a neat symbol of a hydraulic accumulator (1)

5.3 A hydraulic cylinder has a volume of  $620 \times 10^{-6} \text{ m}^3$ .


Calculate the following:



5.3.1 Cross-sectional area of the cylinder if the length of the cylinder is 120 mm


5.3.2 Diameter of the cylinder

5.3.3 Pressure in the cylinder if the exerted force is 40 kN

  
(3 × 2) (6)  
[10]

**QUESTION 6: INTERNAL COMBUSTION ENGINES**

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (6.1–6.5) in the ANSWER BOOK.

- 6.1 The two phases of the two-stroke petrol engine cycle is called the induction phase and the exhaust phase. 
- 6.2 A turbo is suitable only for a petrol engine.
- 6.3 A blower is driven by an engine using a belt drive.
- 6.4 A diesel engine is more expensive to maintain than other engines.
- 6.5 The power output of a diesel engine is generally lower than that of a petrol engine.


(5 × 1) **[5]**

**QUESTION 7: CRANES AND LIFTING MACHINES**

- 7.1 State FIVE disadvantages of a climbing-type tower crane. (5)
- 7.2 State THREE functions of a fibre core in a steel rope. (3)

**[8]**

**QUESTION 8: MATERIALS AND MATERIAL PROCESSES**

- 8.1 Discuss the process of heat treatment on metal. (2)
- 8.2. Name the colour coding for each of the following metals
- 8.2.1 Silicon chrome steel (1)
- 8.2.2 Cast steel (1)
- 8.3. Briefly describe, in point form, the general behaviour of copper during arc welding.  (4)

**[8]**

**QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING**

- 9.1 Define *grievance*. (2)
- 9.2 State FOUR aims of the Occupational Health and Safety Act, No. 85 of 1993. (4)
- 9.3 Name FOUR types of disciplinary actions that can be taken by the employer against an employee who committed an offence. (4)
- [10]**

**QUESTION 10: ENTREPRENEURSHIP**

- 10.1 Explain the term *small business enterprise*. (4)
- 10.2 What is the ultimate objective of an entrepreneur? (1)
- 10.3 State SIX qualities of an entrepreneur. (6)
- [11]**

**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 (⊥h)*



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

<b>TYPES OF DRIVEN MACHINES</b>	<b>TYPES OF PRIME MOVERS</b>					
	<b>Soft starts</b>			<b>Heavy starts</b>		
	<b>Hours per day duty</b>			<b>Hours per day duty</b>		
	<b>10 and under</b>	<b>Over 10 to 16</b>	<b>Over 16</b>	<b>10 and under</b>	<b>Over 10 to 16</b>	<b>Over 16</b>
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					0,8			0,85			0,9				1.05					
Correction factor																				
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					0,80			0,85			0,90			0,95				
Correction factor																		
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	1 093	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

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	-	-