higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1130**(E)**(J31)T

NATIONAL CERTIFICATE

MECHANOTECHNOLOGY N3

(8190373)

31 July 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 pages, 3 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 only BLUE or BLACK ink.

5.   Start each question on a NEW page.

6.   Write neatly and legibly.

QUESTION 1: BELTS DRIVES; CHAIN DRIVES; CLUTCHES AND COUPLINGS

1.1 You have to design a wedge belt to operate a belt conveyor, using the following information:

Electric motor power   60 kW
Electric motor speed   1 350 r/min
Belt conveyor speed   800 r/min
Type of start   heavy
Duty operation type   heavy
Operational duty hours per day   13
Approximate centre distance between pulleys   1 700 mm
Motor shaft diameter   70 mm
Conveyor shaft diameter   90 mm

Refer to TABLE 1; TABLE 2 or TABLE 3 and calculate the following:

1.1.1   The design power of the electric motor   (2)

1.1.2   The speed ratio between the motor and the conveyor   (2)

1.1.3   The length of the belt   (2)

1.1.4   The correction factor of the belt   (1)

1.2 Give FIVE factors that should be considered when using chain drives.   (5)

1.3 State THREE misalignments that can be accommodated by a flexible tyre coupling.   (3)

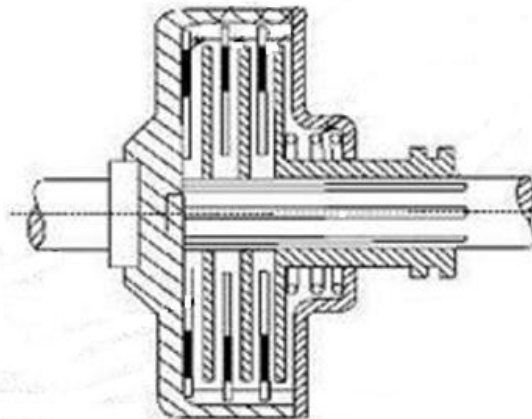1.4 Refer to FIGURE 1 of a clutch below and answer the questions.

FIGURE 1

1.4.1   Name the type of clutch shown in FIGURE 1.   (1)

1.4.2   State ONE disadvantage of this clutch.   (1)

1.5 Centrifugal clutches use the principle of centrifugal force.

Define the term *centrifugal force.* (2)

[19]

QUESTION 2: BRAKES

2.1 Explain the operational principle of an electromagnetic brake system. (4)

2.2 State ONE advantage of a mechanical brake system. (1)

[5]

QUESTION 3: BEARINGS

3.1 Refer to the rolling elements of bearings in FIGURE 2 below.

Name each rolling element by writing only the answer next to the letter (A–E) in the ANSWER BOOK. (5 × 1) (5)
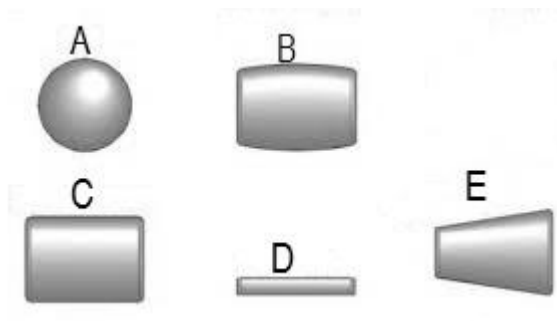

FIGURE 2

3.2 A manufacturer's catalogue is used in the selection of bearings.

State THREE basic factors to consider when selecting the correct type and size of a bearing. (3)

3.3 Each bearing has a significant bearing number. Consider the first THREE characters of a bearing number and state the meaning of each figure as indicated below:

3.3.1 First figure

3.3.2 Second figure

3.3.3 Third figure

(3 × 1) (3)

3.4   All bearings have an operational speed limit.

        State THREE factors that would affect the permissible speed at which anti-
        friction bearings can operate.   (3)
                                                                                  [14]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1   State THREE disadvantages of using a pump with internal packing.   (3)

4.2   Briefly describe the following lubrication methods:

        4.2.1   Splash lubrication   (2)

        4.2.2   Sight feed lubrication   (2)

        4.2.3   Manual feed lubrication   (2)

4.3   Indicate whether the following statements are TRUE or FALSE. Choose the
        answer and write only 'true' or 'false' next to the question number
        (4.3.1–4.3.4) in the ANSWER BOOK.

        4.3.1   In a force feed lubrication process, the operator is directly
                  responsible for the quantity of lubricant applied.

        4.3.2   In a heat exchange system, the tubes are immersed in the water.

        4.3.3   Overcooling results in condensation of fuel

        4.3.4   Dry sump lubrication is ideal for large engines performing heavy
                  duties.
                                                                  (4 × 1)   (4)
                                                                            [13]

QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1   The volume of a hydraulic cylinder is given as $5,876 \times 10^{-5}$ cubic metres (m^3).

Use $\pi = 3,142$

Calculate the following:

5.1.1   The cross-sectional area of the cylinder if the length of the cylinder is 131 mm
Express the answer in mm^2.   (2)

5.1.2   The diameter of the cylinder in millimetres (mm)   (2)

5.1.3   The pressure in the cylinder if the force exerted by the piston is 40 kN.
Express the answer in MPa.   (2)

5.2   Briefly describe THREE functions of an air service unit in a pneumatic system.   (3)
[9]

QUESTION 6: INTERNAL COMBUSTION ENGINES

6.1   Briefly discuss the FOUR strokes produced by a four-stroke petrol engine.   **[8]**

QUESTION 7: CRANES AND LIFTING MACHINES

7.1   There are many different types of cranes.

List FOUR main types of cranes as discussed in your module.   (4)

7.2   Refer to the composition of a steel rope in FIGURE 3 below and label the different parts. Write only the name of each part next to the letter (A–D) in the ANSWER BOOK.
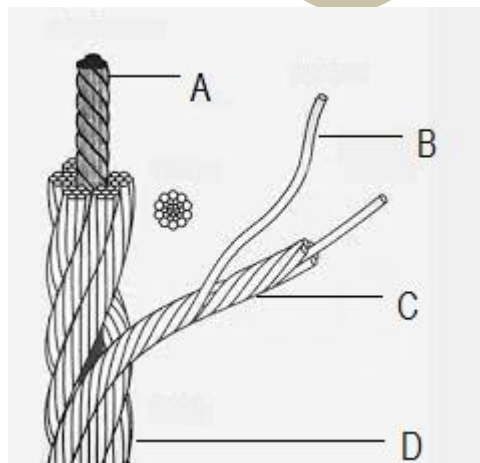

FIGURE 3   (4)
[8]

QUESTION 8: MATERIAL AND MATERIAL PROCESSES

8.1 Different polymers can be distinguished by means of the non-laboratory tests.

Name those FIVE tests (5)

8.2 Annealing is done by slowly heating steel to a certain temperature and then allowing it to cool down very slowly.

State FOUR reasons for annealing steel. (4)

[9]

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1 Describe the term *capital budget.* (3)

9.2 State FOUR advantages of written communication. (4)

[7]

QUESTION 10: ENTREPRENEURSHIP

10.1 Briefly describe the term *symbiosis* as one of the factors that affect the location of a small business enterprise. Give one practical example for your answer. (2)

10.2 'It will be difficult for a person to succeed as a small business entrepreneur without the use of resources'.

List any TWO business resources. (2)

10.3 All business opportunities are based on ideas. An opportunity is `just an idea that can be transformed into a business venture.

State FOUR common ways in which an entrepreneur can generate business ideas on a daily basis. (4)

[8]

TOTAL: 100

TABLE 1

SERVICE FACTORS FOR THE SELECTION OF WEDGE BELTS

	TYPES OF PRIME MOVERS					
	'Soft' starts			'Heavy' starts		
	Hours per day duty			Hours per day duty		
TYPES OF DRIVEN MACHINES	**10 and under**	**10 to 16**	**Over 16**	**10 and under**	**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 shaft 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	-	-

Please turn over

TABLE 3

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	1440 r/min	1260	1340	1410	1590	1800	1900	2020	2150	2280	2400	4560	4820	5070	5380
1.69	236	400	11.94	16.56	-	-	-	-	392	443	504	570	635	696	1779	1909	2034	2189
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	1843	1973	2098	-
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	1788	1918	2043	2198

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* $\left(\perp h\right)$