higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

T1130**(E)(**N23)T

MECHANOTECHNOLOGY N3

(8190373)

23 November 2017 (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 50 kW electric motor, rotating at a speed of 1 150 r/min, drives a grinding machine which rotates at a speed of 570 r/min. The operation is medium-duty, performing for an 8-hour period per day. The corrected power per belt is given as 13 kW, and the system uses a soft-start drive.

Refer to TABLE 1 and TABLE 2 (attached) and answer the following questions:

1.1.1 Calculate the speed ratio between the electric motor and the grinding machine. (2)

1.1.2 Determine the service factor on the drive. (2)

1.1.3 Calculate the design power. (2)

1.1.4 Determine the minimum pulley diameter/s. (1)

1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.2.1 – 1.2.4) in the ANSWER BOOK.

1.2.1 In a belt drive system, ‘slip’ results in a loss of power.

1.2.2 Belt deflection is the amount of movement or slackness in the belt.

1.2.3 Spiral gears are used to transmit power between shafts that are not parallel.

1.2.4 The reduction of speed in gear drives results in an increase in torque.

(4 × 1) (4)

1.3 FIGURE 1 below shows a water pump system.

Name THREE variations that can be obtained when using this type of gear drive. (3)

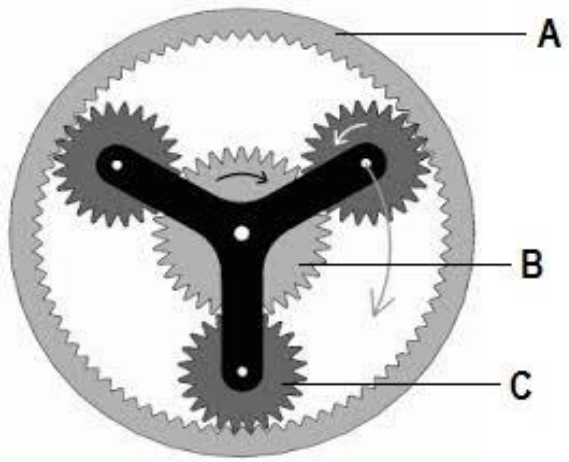

FIGURE 1

1.4 State THREE factors to consider when using couplings. (3 × 2) (6)

[20]

QUESTION 2: BRAKES

2.1 Describe the operational principle of a hydraulic brake system. (4)

2.2 State ONE disadvantage of using cone brakes. (1)
[5]

QUESTION 3: BEARINGS

3.1 Name THREE main types of loads applicable to anti-friction. (3)

3.2 Refer to FIGURE 2 below and label the parts marked A–C. Write only the answer next to the letter (A–C) in the ANSWER BOOK. (3)

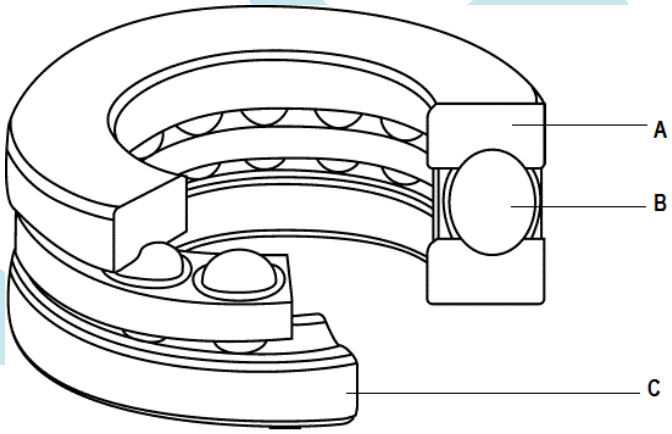

FIGURE 2

3.3 Give THREE causes of vibration and noise in bearings. (3)
[9]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–H) next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1.1	Sudden change in the flow rate of fluid and its pressure.	A	reciprocating pumps
4.1.2	The difference between theoretical flow rate and the real flow rate.	B	mechanical seal
4.1.3	Not suitable for pumping gases.	C	balance disc
4.1.4	In the case of a recirculating line, open the valve in the line.	D	water hammer
4.1.5	A device used to counteract the movement of the shaft and impellers towards the suction side.	E	centrifugal pump
		F	pump slip
		G	stopping procedure
		H	gland

(5 × 1) (5)

4.2 Give THREE reasons why oil should be filtered. (3)

4.3 State TWO advantages of an *impeller-assisted cooling system* over a *thermo-syphon cooling system.* (2)

4.4 Name FIVE causes for the overheating of motor vehicle engines (5)
[15]

QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1 The pressure inside a hydraulic cylinder with an internal cross-sectional area of 0, 00185 m^2 is 480 kPa. Take π = 3,142.

Calculate the following:

5.1.1 The inside diameter of the cylinder in millimetres (mm) (2)

5.1.2 The force exerted on the plunger in newtons (N) (2)

5.2 In simple terms, viscosity can be defined as a fluid's ability to flow.

State THREE negative factors that could result from using a fluid with a very high viscosity content. (3)

5.3 Briefly explain how a hydraulic motor works. (2)
[9]

QUESTION 6: INTERNAL COMBUSTION ENGINE

6.1 FIGURE 3 below shows a two-stroke diesel engine piston in a cylinder.

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

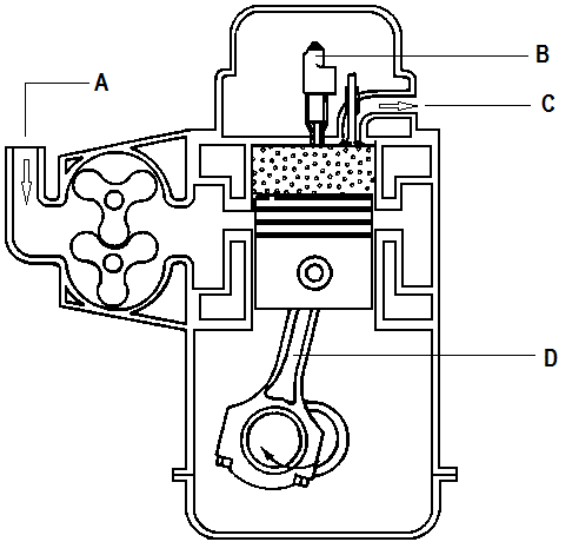

FIGURE 3 (4)

6.2 Name the stroke that is shown in FIGURE 3. (2)
[6]

QUESTION 7: CRANES AND LIFTING MACHINES

7.1 A crane is a multi-purpose machine.

Briefly discuss a crane's main function. (2)

7.2 List FOUR functions of a fibre core in a steel rope. (4)

7.3 'Langs-lay' refers to the weaving method used to manufacture a steel rope.

Briefly state TWO advantages of this weaving method when compared to the 'cross-lay 'weaving method. (2)
[8]

QUESTION 8: MATERIAL AND MATERIAL PROCESSESS

8.1 Explain the results of case hardening on *copper* when it is treated with a carbon-rich material. (2)

8.2 Thermoplastics soften when heated, and solidify again when cooled.

Give FOUR characteristics of thermoplastic materials. (4)

8.3 Metals are coded in order to distinguish one metal from another.

Give the colour code for each of the following metals:

8.3.1 Stainless steel

8.3.2 Low-carbon steel

(2 × 1) (2)
[8]

QUESTION 9: INDUSTRIAL ORGANISATION

9.1 Name FIVE documents that form part of the production process and that assist in managing the budget of an organisation. (5)

9.2 A written communication is a report that is intended to convey information to colleagues.

Give FOUR characteristics of a good report (4)

9.3 Define the term *grievance*. (3)
[12]

QUESTION 10: ENTREPRENEURSHIP

10.1 Briefly explain the term *entrepreneurship*. (4)

10.2 Discuss what is meant by *good qualities of an entrepreneur*. (2)

10.3 Name TWO general resources which you will need as an entrepreneur (2)
[8]

TOTAL: 100

TABLE 1

SERVICE FACTORS FOR THE SELECTION OF WEDGE BELTS

	TYPES OF PRIME MOVERS					
	'Soft' starts			**'Heavy' starts**		
TYPES OF DRIVEN MACHINES	**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	-	-

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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* $(\perp h)$