PAST EXAM PAPER & MEMO N3

ABOUT THE QUESTION PAPERS:

THANK YOU FOR DOWNLOADING THE PAST EXAM PAPER AND ITS MEMO, WE HOPE IT WILL BE OF HELP TO YOU. SHOULD YOU NEED MORE QUESTION PAPERS AND THEIR MEMOS PLEASE SEND US AN EMAIL TO INFO@EKURHULENITECH.CO.ZA AND WE WILL SEND YOU A FULL DOWNLOAD VERSION OF THESE. HOWEVER PLEASE NOTE THAT THESE ARE SOLD FOR A SMALL AMOUNT OF R300 PER DOWNLOAD PER SUBJECT.

ABOUT REGISTERING WITH OUR COLLEGE

CONSIDER REGISTERING WITH OUR COLLEGE AND WE HAVE THE FOLLOWING TYPES OF LEARNING:

✓ **ONLINE OR CORRESPONDENCE LEARNING.** THIS IS THE MOST PREFERED ONE BY THOUSANDS
✓ **PART-TIME CLASSES** DURING SATURDAYS IF NEAR OUR OFFICES IN KRUGERSDORP
✓ **FULL-TIME CLASSES** IF NEAR OUR CLASSES IN KRUGERSDORP

ABOUT EXTRA TEXTBOOKS

IF LOOKING FOR TEXTBOOKS FOR CERTAIN SUBJECTS I N1-N6 ENGINEERING STUDIES PLEASE SEND US AN EMAIL ON INFO@EKURHULENITECH.CO.ZA

ABOUT VIDEO MATERIAL

WE HAVE VIDEO MATERIAL FOR EXTRA UNDERSTANDING ON CERTAIN ENGINEERING FOR A FEE. REQUEST A QUOTE. SEND US AN EMAIL ON INFO@EKURHULENITECH.CO.ZA
T1070(E)(A5)T
APRIL EXAMINATION

NATIONAL CERTIFICATE
MECHANOTECHNOLOGY N3
(8190373)
5 April 2016 (X-Paper)
09:00–12:00

This question paper consists of 7 pages, 2 tables of 4 pages and 1 formula sheet.
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 blower rotating at a speed of 700 r/min is driven by a 30 kW electric motor which rotates at 1200 r/min. This is a medium-duty operation that performs an eleven hours duty per day. The type of start used for this drive is 'soft'.

Refer to TABLE 1 and TABLE 2 and answer the following questions:

1.1.1 Calculate the speed ratio. (1)
1.1.2 Determine the service factor. (1)
1.1.3 Calculate the design power. (1)
1.1.4 Determine the minimum pulley diameter. (1)
1.1.5 Calculate the number of belts if the corrected power per belt is 20,89 kW. (2)

1.2 State FOUR advantages of worm and worm-wheel gear. (4 x 1) (4)

1.3 Refer to FIGURE 1 which shows a representation of a universal coupling and label the parts (A–E) in the ANSWER BOOK.

1.4 Give FIVE main factors that determine the use of a friction clutch. (5 x 1) (5)

Copyright reserved
Please turn over
QUESTION 2: BRAKES

State FIVE disadvantages of mechanical brakes. (5 x 1) [5]

QUESTION 3: BEARINGS

3.1 Explain the difference between friction bearings and anti-friction bearings. (2)

3.2 Refer to FIGURE 2 and answer the questions.

- 3.2.1 Name the type of bearing shown. (1)
- 3.2.2 Name the types of loads the above bearing can carry. (2)
- 3.2.3 State the main advantage of the bearing. (1)
- 3.3 State FOUR features of the guide friction bearing. (4) [10]

QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1 Explain the term water hammer. (3)

4.2 Apart from using an oil can or a grease pot, list FIVE other methods that can be used to apply lubrication on machine parts and components. (5 x 1) (5)

4.3 Explain the difference between a piston and a plunger. (2)

4.4 Name FIVE possible causes of breakdowns in centrifugal pumps. (5 x 1) [15]
QUESTION 5: HYDRAULICS AND PNEUMATICS

5.1 A hydraulic system consists of two hydraulic cylinders. In cylinder A the input side, a force of 1 200 N was applied on the plunger.

The following information is also known:

- The work done in cylinder A when the force was applied: 250 joules
- The diameter of cylinder A: 75 mm
- The diameter of cylinder B: 260 mm

NOTE: Use \( \pi = 3.1416 \) and calculate the following:

5.1.1 The distance that the plunger in cylinder A moved. Express the answer in millimetres (mm).

5.1.2 The volume of fluid displaced in cylinder A during the work done process. Express the answer in cubic meter (m³).

(2 x 2) (4)

5.2 The fluid in a hydraulic system is vitally important.

State TWO characteristics of hydraulic fluid in this regard. (2 x 1) (2)

5.3 Make neat drawings (NO freehand sketches) of the ISO symbols as applicable hydraulic systems of the following:

5.3.1 A directional control valve
5.3.2 A flow control valve (adjustable)
5.3.3 An actuator (linear)
5.3.4 A flow control valve (fixed)

(4 x 1) (4)
QUESTION 6: INTERNAL COMBUSTION ENGINES

Refer to FIGURE 3 of a two-stroke diesel engine and answer the questions:

6.1 Name the components (A–C). (3)

6.2 Name the TWO phases during the downwards stroke of a piston. (2 x 1) (2)

QUESTION 7: CRANES AND LIFTING MACHINES

7.1 Give FOUR advantages of using mobile cranes. (4 x 1) (4)

7.2 A typical steel rope that is used in cranes can be describes as: 30 mm diameter, 6 x 36 (9/9/1), fibre core, Langs lay.

   Explain the meaning of the numbers 6 x 36 steel rope. (2)

7.3 State TWO characteristics of a steel rope with a wire core. (2 x 1) (2)

Copyright reserved
QUESTION 8: MATERIAL AND MATERIAL PROCESSES

8.1 Describe THREE characteristics of non-ferrous metals. (3 x 1) (3)

8.2 Give TWO examples of non-ferrous metals. (2 x 1) (2)

8.3 State the basic characteristics from non-laboratory tests with reference to the hardness of the following:
   8.3.1 Natural rubber (NR) (2 x 1) (2)
   8.3.2 Nylon

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1 List FIVE documents that form part of the production process and assist in managing the budget of an organisation. (5 x 1) (5)

9.2 List THREE methods that can be used to improve horizontal communication. (3 x 1) (3)

9.3 Employees fail to report incidents for various reasons.
   Give FOUR reasons that make them not to report an incident. (4 x 1) (4)

QUESTION 10: ENTREPRENEURSHIP

10.1 State FIVE characteristics of an entrepreneur. (5 x 1) (5)

10.2 Name THREE sources that an entrepreneur can use to research or to explore possible business opportunities. (3 x 1) (3)

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 (h)
## TABLE 1

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

<table>
<thead>
<tr>
<th>TYPES OF DRIVEN MACHINES</th>
<th>TYPES OF PRIME MOVERS</th>
<th>'Soft' starts</th>
<th>'Heavy' starts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours per day duty</td>
<td>Hours per day duty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 and under</td>
<td>Over 10 to 16</td>
</tr>
<tr>
<td><strong>Class 1 - Light duty</strong></td>
<td>Blowers and fans</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Centrifugal compressors and pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Belt conveyors (uniformly loaded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Class 2 - Medium duty</strong></td>
<td>Blowers and fans</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Rotary compressors and pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Belt conveyors (not uniformly loaded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Generators</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Class 3 - Heavy duty</strong></td>
<td>Brick machinery</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Compressors and pumps (reciprocating)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conveyors (heavy duty)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hammer mills</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Punches and presses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Class 4 - Extra heavy duty</strong></td>
<td>Crushers</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Mills</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2

**CENTRE DISTANCES FOR 16 N SPB WEDGE BELT DRIVES**

<table>
<thead>
<tr>
<th>Combined arc and belt length</th>
<th>Correction factor</th>
<th>0.8</th>
<th>0.85</th>
<th>0.9</th>
<th>1.05</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BELT LENGTH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Pitch diameter of pulleys</td>
<td>Power per belt kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>960 r/min</td>
<td>1 440 r/min</td>
<td>1 260</td>
<td>1 340</td>
<td>1 410</td>
<td>1 590</td>
</tr>
<tr>
<td>1.69</td>
<td>236</td>
<td>400</td>
<td>11.94</td>
<td>16.56</td>
<td>-</td>
</tr>
<tr>
<td>1.75</td>
<td>160</td>
<td>280</td>
<td>6.45</td>
<td>8.92</td>
<td>278</td>
</tr>
<tr>
<td>1.75</td>
<td>180</td>
<td>315</td>
<td>7.92</td>
<td>11.00</td>
<td>-</td>
</tr>
<tr>
<td>1.78</td>
<td>200</td>
<td>355</td>
<td>9.38</td>
<td>13.03</td>
<td>-</td>
</tr>
<tr>
<td>1.79</td>
<td>140</td>
<td>250</td>
<td>4.95</td>
<td>6.80</td>
<td>319</td>
</tr>
<tr>
<td>1.79</td>
<td>224</td>
<td>400</td>
<td>11.10</td>
<td>15.41</td>
<td>-</td>
</tr>
</tbody>
</table>
TABLE 2
CENTRE DISTANCES FOR 22 N SPC WEDGE BELT DRIVES

<table>
<thead>
<tr>
<th>Speed Ratio</th>
<th>Pitch diameter of pulleys</th>
<th>Power per belt kW</th>
<th>BELT LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Driver / Driven / 960 r/min / 1 440 r/min</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>1,58</td>
<td>400 / 630</td>
<td>37,85 / 49,15</td>
<td>- / - / -</td>
</tr>
<tr>
<td>1,58</td>
<td>300 / 475</td>
<td>25,19 / 33,63</td>
<td>- / 443 / 504</td>
</tr>
<tr>
<td>1,58</td>
<td>224 / 355</td>
<td>14,82 / 19,80</td>
<td>542 / 602 / 662</td>
</tr>
<tr>
<td>1,59</td>
<td>315 / 500</td>
<td>27,16 / 36,17</td>
<td>- / - / 471</td>
</tr>
<tr>
<td>1,59</td>
<td>236 / 375</td>
<td>16,50 / 22,09</td>
<td>516 / 576 / 637</td>
</tr>
<tr>
<td>1,60</td>
<td>250 / 400</td>
<td>18,44 / 24,71</td>
<td>484 / 545 / 605</td>
</tr>
</tbody>
</table>
## TABLE 2

MINIMUM PULLEY DIAMETER (mm)

<table>
<thead>
<tr>
<th>Speed of faster shaft r/min</th>
<th>Minimum pulley diameter (mm)</th>
<th>Design Power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1</td>
<td>Up to 1</td>
<td>Up to 1</td>
</tr>
<tr>
<td></td>
<td>3,0</td>
<td>4,0</td>
</tr>
<tr>
<td></td>
<td>5,0</td>
<td>7,5</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>720</td>
</tr>
<tr>
<td></td>
<td>720</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>960</td>
<td>1 200</td>
</tr>
<tr>
<td></td>
<td>1 200</td>
<td>1 440</td>
</tr>
<tr>
<td></td>
<td>1 440</td>
<td>1 800</td>
</tr>
<tr>
<td></td>
<td>1 800</td>
<td>2 800</td>
</tr>
<tr>
<td></td>
<td>2 800</td>
<td></td>
</tr>
</tbody>
</table>

- Copyright reserved
MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

MECHANOTECHNOLOGY N3

5 APRIL 2016

This marking guideline consists of 8 pages.
QUESTION 1: POWER TRANSMISSION

1.1 1.1.1 Speed Ratio = \( \frac{\text{Speed of faster pulley}}{\text{Speed of slower pulley}} \)
\[ \therefore \text{SR} = \frac{1200}{700} \]
\[ \therefore \text{SR} = 1.71 : 1 \]  

(1)

1.1.2 Type of start = soft
Hours per day = 11

Read from TABLE 1
The service factor (SF) is 1.2

(1)

1.1.3 Design power (P) = \( P \times SF \)
\[ P = 30 \times 1.2 \]
\[ \therefore P = 36 \text{ KW} \]  

(1)

1.1.4 Refer to TABLE 2:

Consider:
\[ N = 1200 \text{ r/min} \]
Design power = 36 KW
\[ \therefore d = 160 \text{ mm} \]  

(1)

1.1.5 \[ \therefore \text{No of belts} = \frac{\text{Design power}}{\text{Corrected power/belts}} \]
\[ = \frac{36}{\sqrt{20.89}} \]
\[ = 1.723 \text{ belts} \sqrt{} \]
\[ = \text{use 2 belts} \]  

(2)

1.2 • It can greatly reduce speed. ✓
• It can change direction of the drive or rotation. ✓
• The drive is silent ✓ in operation.
• We can obtain an increase in drive. ✓

(4 x 1)  

(4)

1.3 A Shaft A
B Yoke
C Key
D Shaft B
E Cross piece

(5 x 1)  

(5)
1.4  
- The **power** ✓ which must be transmitted  
- The **speed** ✓ at which the drive must take place  
- The **amount of torque** ✓ to be transmitted  
- The **duration** ✓ of slip needed  
- How often the machine will **engage and disengage** ✓  
- The **condition** ✓ under which the clutch is going to operate  

(Any 5 x 1) (5)  

[20]

**QUESTION 2: BRAKES**

- They require frequent attention to keep it effective due to the large numbers of levers and pivot points.  
- Continuously wear of the lining means that the adjuster must be adjusted frequently.  
- Dust and water have a detrimental effect on its operation.  
- Cables and rods have a tendency to stretch which leads to loss in braking.  
- It is a slow-response braking system.  

(5 x 1) [5]

**QUESTION 3: BEARINGS**

3.1  
- Friction bearings operate on the principle of sliding friction. ✓  
- Anti-friction bearings operate on the principle of rolling motion. ✓  

(2 x 1) (2)

3.2  
3.2.1 Spherical roller bearing ✓  

(1)

3.2.2  
- Very high radial loads ✓  
- Axial loads acting in both directions ✓  

(2)

3.2.3  
- The bearing is self-aligning ✓  

(1)

3.3  
- They are **quiet** ✓ in operation  
- They are **cheap or low in cost** ✓.  
- They have great **rigidity** ✓.  
- They can be **easily repaired** ✓ when they are worn.  

(4 x 1) [4]
QUESTION 4: WATER PUMPS, COOLING AND LUBRICATION

4.1 Water hammer is caused by a **sudden change in speed** at which the fluid is moving, together with a proportional **change in pressure**. This causes a loud hammer sound in the pipeline, which is called the ‘**knock’ sound’. 

(3)

4.2
- Splash lubrication ✓
- Syphon-wick lubrication ✓
- Sight-feed lubrication ✓
- Force-feed lubrication ✓
- Dry- sump lubrication ✓
- Lubrication by mixing oil and petrol ✓

(Any 5 x 1) (5)

4.3
- The length of the plunger is **longer than its stroke**. ✓
- The length of the piston is **shorter than its stroke**. ✓
- The packing of the plunger is housed in a **stuffing box** at the end of the housing
- The piston has packing rings that are inserted on the **rim of the piston** to prevent leakage.

(Any 2 x 1) (2)

4.4
- Air in the pump casing or suction column that slips into the pump at the flanges or at the stuffing boxes.
- The suction head may be too high, especially in recently installed pumps.
- Blockage in the strainer.
- The strainer may be exposed above the fluid level.
- A faulty foot valve that stays open.
- The pressure inside the pump may be too low because pumping velocity is too low.
- Moving parts of the pump may be worn, so that clearance between the impeller and the casing is too big.

(Any 5 x 1) (5)
QUSTION 5: HYDRAULICS AND PNEUMATICS

5.1 5.1.1 For distance that plunger moved (S):

Work done (W) = Force $\times$ Distance

$W = F \times S$

$250 = 1 \times 200 \times S$ ✓

$S = \frac{250}{1 \times 200}$

$0,208 \text{ m} = 208 \text{ mm}$ ✓

5.1.2 For volume of fluid displacement (v):

$V = A \times S$

$V = \frac{\pi \times d^2}{4} \times S$

$= \frac{\pi \times 0,075^2}{4} \times 0,208$ ✓

$= 9,189 \times 10^{-4} \text{ m}^3$ ✓

(2 x 2) (4)

5.2

- They are infinitely flexible. ✓
- Hydraulic fluid cannot be compressed. ✓
- The pressure which is supplied to the system is available for work at any junction in the hydraulic system. ✓

(Any 2 x 1) (2)

5.3 5.3.1

5.3.2

5.3.3

5.3.4

(4 x 1) (4)

[10]
QUESTION 6: INTERNAL COMBUSTION ENGINES

6.1  A – Blower supplies air to intake ✓
     B – Intake port ✓
     C – Exhaust port ✓

     (3 x 1) (3)

6.2  • Induction phase ✓
     • Exhaust phase ✓

     (2 x 1) (2) [5]

QUESTION 7: CRANES AND LIFTING MACHINES

7.1  • They can move from point A to point B under their own power while carrying the load. ✓
     • Mobile cranes are allowed to move from one stand to another on public roads, as long as they comply with traffic regulations. ✓
     • Heavy loads can be lifted to great heights. ✓
     • Because mobile cranes can move forward and backward under their own power, heavy load can be reached and removed from difficult to reach points. ✓
     • The crane jib can reach and pick up loads far from the crane. ✓

     (Any 4 x 1) (4)

7.2  • The number 6 indicates the number of strands ✓ that makes up the steel ropes.
     • The number 36 indicates the number of wires ✓ each strand contains.

     (2)

7.3  • It can be exposed to high temperatures ✓.
     • The strength ✓ of the rope is increased.

     (2) [8]
QUESTION 8: MATERIAL AND MATERIAL PROCESSES

8.1
- It contains no irons ✓
- Non-magnetic ✓
- Corrosion resistant ✓  
  (3 x 1)  (3)

8.2
- Copper
- Aluminium
- Tin
- Lead
- Zinc
- Antimony  
  (Any 2 x 1)  (2)

8.3
8.3.1 Very soft ✓
8.3.2 Stiff ✓  
  (2 x 1)  (2)

QUESTION 9: INDUSTRIAL ORGANISATION AND PLANNING

9.1
- Clock cards ✓
- Job cards ✓
- Requisition cards ✓
- Production flow cards ✓
- Maintenance schedules ✓  
  (5 x 1)  (5)

9.2
- Interdepartmental meeting ✓
- Co-operation incentive ✓
- Social meeting ✓  
  (3 x 1)  (3)

9.3
- Fear of discipline
- Concern about record
- Concern about reputation
- Fear of medical treatments
- Dislike of medical personnel
- Desire to prevent work interruption
- Desire to keep personal record clear
- Avoidance of red tape
- Concerned about relationship with others
- Poor understanding of importance  
  (Any 4 x 1)  (4)

[12]
QUESTION 10: ENTREPRENEURSHIP

10.1 • Self-confidence  
• Persistence  
• Opportunity-seeking ability  
• Commitment strength  
• Risk-taking ability  
• Good setting ability  
• Demand for quality and efficiency  
• Information ability  
• Systematic planning and monitoring  
• Persuasion and networking  
\( \text{(Any 5 x 1)} \) (5)

10.2 • Trade show and exhibitions  
• Visit a factory or manufacturer  
• Flea markets  
• Research expired patent  
• Check overseas products  
• Manipulate existing product or services or modify old products  
• Be a copycat  
• Visit places where people gather  
\( \text{(Any 3 x 1)} \) (3)

\[ \text{TOTAL: 100} \]
REGISTERING WITH OUR COLLEGE

CONSIDER REGISTERING WITH OUR COLLEGE AND WE HAVE THE FOLLOWING TYPES OF LEARNING:

✓ ONLINE OR CORRESPONDENCE LEARNING. THIS IS THE MOST PREFEARED ONE BY THOUSANDS

✓ PART-TIME CLASSES DURING SATURDAYS IF NEAR OUR OFFICES IN KRUGERSDORP

✓ FULL-TIME CLASSES IF NEAR OUR CLASSES IN KRUGERSDORP

ABOUT EXTRA TEXTBOOKS

IF LOOKING FOR TEXTBOOKS FOR CERTAIN SUBJECTS IN N1-N6 ENGINEERING STUDIES PLEASE SEND US AN EMAIL ON INFO@EKURHULENITECH.CO.ZA

ABOUT VIDEO MATERIAL

WE HAVE VIDEO MATERIAL FOR EXTRA UNDERSTANDING ON CERTAIN ENGINEERING FOR A FEE. REQUEST A QUOTE. SEND US AN EMAIL ON INFO@EKURHULENITECH.CO.ZA