Calculators may be used.

Candidates will require drawing instruments, pens and a ruler.

This question paper consists of 8 pages, 1 diagram sheet and a 1-page formula sheet.
DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
FITTING AND MACHINING THEORY N2
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked, must be clearly crossed out.

INSTRUCTIONS AND INFORMATION
1. Answer ALL the questions in SECTION A.
2. Answer ONLY TWO questions in SECTION B.
3. Answer ONLY question 1.1 or 1.2 of question 1.
4. Read ALL the questions carefully.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Write neatly and legibly.
SECTION A

QUESTION 1: OCCUPATIONAL SAFETY

NOTE: Answer ONLY question 1.1 OR question 1.2.

1.1 Give FOUR examples of 'dangerous places', as stated in the applicable regulations and in terms of the Occupational Health and Safety Act. [4]

OR

1.2 Explain in your OWN words, FOUR regulations and preventative measures associated with fire prevention on mines (Mining Industry). [4]

QUESTION 2: COUPLINGS

2.1 Name TWO couplings which fall under the classification of self-aligning couplings. [2]

2.2 FIGURE 1 in the DIAGRAM SHEET (attached), shows an example of a typical flexible coupling. With reference to FIGURE 1, answer the following questions:

2.2.1 What is the name of the coupling in FIGURE 1? [1]

2.2.2 Describe the operation of the coupling in FIGURE 1, by completing the missing words in the paragraphs below: Write the answer next to the question number (2.2.2(a) – 2.2.2(d)) in the ANSWER BOOK.

'These couplings allow for (a) ... and (b) ...-misalignment of shafts. Flanges are fitted onto shaft ends and are keyed into position.

The holes for fixing the two flanges are lined up directly opposite each other. Instead of accurately machined bolts, pins are fitted that are much smaller than the diameter of the holes.

This pins are fitted into (c) ... that fit into the boltholes. This means that flexible rubber components make the coupling flexible enough to cope with any misalignment.

Where heavy loads are experienced it is necessary to (d) ... the number of pins to the couplings.' [4] [7]
QUESTION 3: LIMITS AND FITS

3.1 FIGURE 2, DIAGRAM SHEET (attached) shows an example of an interference fit between a bush and shaft. Name the different parts as indicated by the letters (A – D) in FIGURE 2 in the ANSWER BOOK.

3.2 A precision running fit between a shaft and a sliding bearing is given as 45H7-g6. What is meant by the following symbols?

3.2.1 The capital letter H
3.2.2 The number 7
3.2.3 The small letter g
3.2.4 The number 6

QUESTION 4: BEARINGS

4.1 FIGURE 3, illustrates three plain bearing types. Name the THREE types as indicated by the letters from (A – C) in the ANSWER BOOK.

4.2 State FOUR properties of the materials used for plain bearings.

4.3 Give FOUR reasons for the failure of anti-friction bearings.

QUESTION 5: LUBRICATION AND VALVES

5.1 State FOUR factors which must be considered when choosing a lubricant.

5.2 Explain in your OWN words the basic working principle of a gate-valve with reference to:

5.2.1 The pressure rating
5.2.2 The operation of the 'gate'
5.2.3 Direction of flow

QUESTION 6: PACKING, STUFFING BOXES, JOINTS AND WATER PIPE SYSTEMS

6.1 State FOUR important guidelines for the correct choice of O-rings and seals in hydraulic systems when fitting a new seal.

6.2 Name FIVE common joint methods for coping with expansion and contraction in pipe systems.
QUESTION 7: PUMPS

7.1 Explain, in your OWN words, the function of a balancing disc when dealing with multistage centrifugal pumps. (1)

7.2 FIGURE 4, DIAGRAM SHEET (attached), shows a sketch of a single-acting pump. Name the parts of the pump as indicated by the letters (A – D) in the sketch in the ANSWER BOOK. (4)

QUESTION 8: COMPRESSORS

Explain the function of each of the following compressor components:

8.1 Filter (1)
8.2 Drain valve (1)
8.3 Intercooler (1)
8.4 After cooler (1)
8.5 Pressure regulator (5)

QUESTION 9: V-BELT, GEAR AND CHAIN DRIVES

9.1 Give ONE reason why 'slip' is an advantage and ONE reason why 'slip' is a disadvantage in terms of belt drives over other types of drives. (2)

9.2 Use the leading phrases given below to answer the questions. State THREE measures you would take when performing maintenance on a gearbox.

9.2.1 Bearings? (1)
9.2.2 Before dismantling? (1)
9.2.3 Removal of shims? (1)

TOTAL SECTION A: 60
SECTION B

Answer only TWO questions in SECTION B.

QUESTION 10: HYDRAULICS AND PNEUMATICS

10.1 State the TWO physical properties which will determine the force with which an actuator operates. (2)

10.2 State FOUR factors to consider when choosing between the use of hydraulic or pneumatic systems when designing a fluid drive. (4)

10.3 State the THREE main functions of oil in a hydraulic flow system. (3)

10.4 Name TWO functions of the reservoir. (2)

10.5 Answer the following questions based on the directional control valve, as shown in FIGURE 5, DIAGRAM SHEET (attached):

10.5.1 How many ports are indicated? (1)

10.5.2 How many switching positions are indicated? (1)

10.5.3 Is this valve normally open or normally closed? (1)

10.5.4 What is the name of this valve? (1)

10.6 Make neat, simple, freehand sketches of the symbols representing the following pneumatic components:

10.6.1 Compressor (1)

10.6.2 Pneumatic motor (1)

10.6.3 Pressure source (1)

10.6.4 Regulator valve (1)

10.6.5 Thermometer (1)
QUESTION 11: CENTRE LATHES

11.1 Name THREE basic instructional formats applicable to a CNC lathe. (3)

11.2 A spindle with a total length of 150 mm is to be turned to the dimensions given in FIGURE 6, DIAGRAM SHEET (attached).

11.2.1 Calculate the amount of tailstock set-over. (3)

11.2.2 Calculate the included angle of the tapered portion. Give the answer in degrees and minutes. (1)

11.3 A carbon steel pin with a diameter of 10 mm is to receive a finishing cut on a center lathe. The cutting speed for carbon steel is 56.55 m/min. Calculate the speed adjustment in r/min of the lathe.

NOTE: Use the formula: \( S = \pi DN \)

\( N \) = Spindle speed of machine;
\( S \) = Cutting speed;
\( D \) = Diameter of the work-piece. (3)

11.4 Steadies are important accessories to a centre lathe. Answer the following:

11.4.1 Give TWO functions of lathe-steadies. (2)

11.4.2 What is the steady which is mounted to the lathe-bed called? (1)

11.4.3 What is the steady which is mounted to the lathe-saddle called? (1)

11.5 A single-start square thread of 10 mm pitch, has to be machined on a round shaft with an outside diameter of 80 mm. The pitch diameter is 75 mm.

Calculate the following:

11.5.1 The helix angle (\( \theta \)) of the thread (3)

11.5.2 The lead angle of the cutting tool (1)

11.5.3 The following angle of the cutting tool (1)

11.5.4 The axial distance a nut would travel after screwing it on this thread for ONE revolution? (1)

[20]
QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 Name the FOUR types of indexing as performed on a milling machine. (4)

12.2 Name an accessory you would use to perform any of the indexing named in QUESTION 12.1. (1)

12.3 A milling machine is used to machine 54 gear teeth on the circumference of a round work-piece. (1)

12.3.1 Name the type of indexing that can be performed on this gear blank. (1)

12.3.2 Calculate the required indexing using a Browne and Sharpe dividing head.

NOTE: Browne and Sharpe indexing information as shown below:

<table>
<thead>
<tr>
<th>The Browne and Sharpe Dividing Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate 1</td>
</tr>
<tr>
<td>Plate 2</td>
</tr>
<tr>
<td>Plate 3</td>
</tr>
</tbody>
</table>

12.4 Grinding wheels have markings for identification purposes. State the FIVE categories by which a grinding wheel could be identified. (5)

12.5 State FOUR advantages of using helical milling cutters with nicked teeth. (4)

12.6 Name TWO types of milling processes used for slab or flat surface milling. (2)

TOTAL SECTION B: 40
GRAND TOTAL: 100
Fitting and Machining Theory N2

Formula Sheet

\[ f = f_t \times T \times N \]

\[ S = \frac{\pi DN}{60} \]

\[ S = \pi DN \]

\[ \frac{40}{N} \]

\[ \frac{N}{90} \]

\[ \frac{D - d}{2} \times \frac{\text{length of workpiece}}{\text{length of taper}} \]

\[ \tan \left( \frac{\theta}{2} \right) = \frac{X}{L} \]

90° - (Helix angle + clearance angle)

90° + (Helix angle - clearance angle)

Lead = No of starts × pitch