



**higher education  
& training**

---

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

**NATIONAL CERTIFICATE**

**FITTING AND MACHINING THEORY N2**

(11022032)

**21 November 2019 (X-Paper)**

**09:00–12:00**

**Calculators and drawing instruments may be used.**

**This question paper consists of 9 pages and 1 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 will be marked. Clearly cross out ALL work you do NOT want to be marked.

**INSTRUCTIONS AND INFORMATION**

1. Answer ALL the questions in SECTION A, except for QUESTION 1 where you must answer either QUESTION 1.1 OR QUESTION 1.2.
  2. Answer any TWO questions in SECTION B.
  3. Read ALL the questions carefully.
  4. Number the answers according to the numbering system used in this question paper.
  5. Write neatly and legibly.
-

**SECTION A****QUESTION 1: OCCUPATIONAL SAFETY**

Answer only QUESTION 1.1 **OR** QUESTION 1.2.

- 1.1 State FIVE basic safety measures to take when working with pneumatic tools, equipment and machinery. (5)



**OR**

- 1.2 State the special measures to take when working on machinery with regard to the following:

1.2.1 Loose clothing

1.2.2 Exposure of machinery that is in motion

1.2.3 Shifting driving belts 

1.2.4 Repairing and lubrication of machinery in motion

1.2.5 Condition of safety appliances (5 × 1) (5)  
**[5]**

**QUESTION 2: COUPLINGS**

Draw neat, labelled diagrams to show THREE types of misalignment. (3 × 2) **[6]**

**QUESTION 3: LIMITS AND FITS**

- 3.1 State the type of fit described by each of the following statements:

3.1.1 Two mating parts fit into each other smoothly but not loosely.

3.1.2 A medium pressure is applied to fit one components into the other.

3.1.3 A high pressure is needed to assemble the components together.

3.1.4 The inside diameter of one component is expanded by heat to fit over a shaft and then cooled.



(4 × 1) (4)

3.2 The diameter of a hole is given as  $20 \begin{matrix} +0,025 \text{ mm} \\ -0,005 \text{ mm} \end{matrix}$ .

Determine each of the following dimensions:

3.2.1 Nominal size

3.2.2  High limit

3.2.3 Low limit

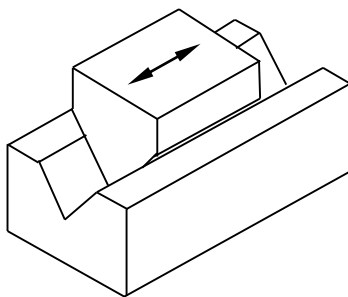
(3 × 1)

(3)

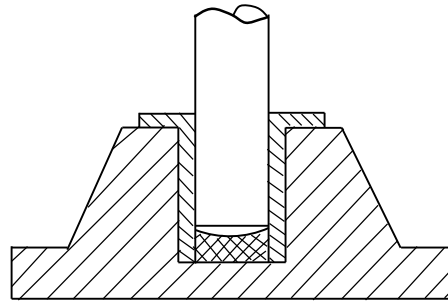
[7]

### QUESTION 4: BEARINGS

The diagrams in FIGURE 1 illustrate TWO bearing types.



A



B

FIGURE 1



4.1 Identify the bearings labelled A and B.

(2)

4.2 State ONE function of each of the bearings labelled A and B.

(2)

4.3 Give ONE example of where bearing A is used.

(1)



[5]

### QUESTION 5: LUBRICATION AND VALVES

5.1 Give FIVE reasons why work pieces must be lubricated while being machined.



(5)

5.2 Name the type of valve that allows flow in one direction only.

(1)

[6]

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

- 6.1 Give TWO reasons for insulating water and steam pipelines. (2)
- 6.2 Explain why a joint is normally made of compressible material. (2)
- 6.3 State ONE condition under which the *continuous expansion bend* is used in industry. (1)
- 6.4 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–D) next to the question number (6.4.1–6.4.4) in the ANSWER BOOK. (4)

COLUMN A		COLUMN B	
6.4.1	Connects two pipes of different diameters	A	cross piece
6.4.2	More than one pipe must be connected and joined from four directions	B	pipe nipple
6.4.3	Connects two pipes where both pipes have internal threads	C	socket
6.4.4	Connects two pipes having an external thread on its diameter	D	reducing socket

(4 × 1)

(4)  
[9]

**QUESTION 7: PUMPS**

FIGURE 2 shows a diagram of a certain type of pump.



**FIGURE 2**

- 7.1 Name the pump in FIGURE 2. (1)
- 7.2 Label the parts of the pump by writing only the answer next to the letter (A–C) in the ANSWER BOOK. (3 × 1) (3)
- 7.3 Explain the working principle of the pump shown in FIGURE 2. (2)

[6]

**QUESTION 8: COMPRESSORS**

State the function of each of the following compressor components:

8.1 Pressure gauge

8.2 Piston 

8.3 Piston rings


8.4 Connecting rod

(4 × 1) [4]

**QUESTION 9: V-BELTS, GEAR DRIVES, CHAIN DRIVES AND REDUCTION GEARBOXES**

9.1 Explain the meaning of each of the following V-belt drive terms:


9.1.1 Pulley pitch diameter

9.1.2 Belt pitch length 

9.1.3 Centre distance

(3 × 1) (3)


9.2 Draw neat line diagrams of a the following gear drives:

9.2.1  A simple gear drive (1)

9.2.2 A compound gear drive (2)

9.3 Name THREE types of lubrication methods used on chain drives. (3)

9.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (9.4.1–9.4.3) in the ANSWER BOOK.

9.4.1 The force transmission through a worm reducer is at right angles at all times. 

9.4.2 A worm and worm-wheel reduction gearbox can rotate in a reverse direction.

9.4.3 The *worm* of the worm and worm wheel reduction gear is regarded as the input gear.

(3 × 1) (3)  
[12]

**TOTAL SECTION A: 60**


**SECTION B**

Answer any TWO questions.

**QUESTION 10: HYDRAULICS AND PNEUMATICS**

10.1 State the TWO main factors in the functioning of a hydraulic system. (2)

10.2 State TWO units of pressure measurement. (2)

10.3 State THREE functions of hydraulic fluid.  (3)

10.4 State the function of each of the following valves used in hydraulic systems:

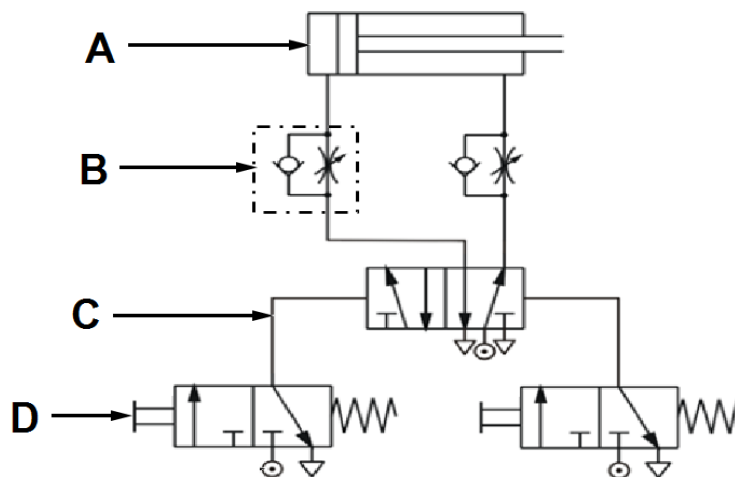
10.4.1 Regulator (1)

 10.4.2 Pressure relief (1)

10.4.2 Directional control valve (1)


10.5 State the function of a pneumatic system. (1)

10.6 FIGURE 3 shows a circuit diagram of a pneumatic system.



**FIGURE 3**

Label the components of the pneumatic system by writing only the answer next to the letter (A–D) in the ANSWER BOOK. (4 × 1) (4)

10.7 State FIVE tasks that must be carried out during the daily maintenance on pneumatic systems.  (5)

**[20]**

**QUESTION 11: CENTRE LATHES**

11.1 Explain the following terms applicable to CNC machines:



11.1.1 G-commands

(1)

11.1.2 Absolute programming

(1)

11.2 State FOUR advantages of using mandrels.

(4)

11.3 Name the tool you would use to support long slender work against bending due to its own weight or the pressure of the cutting tool.

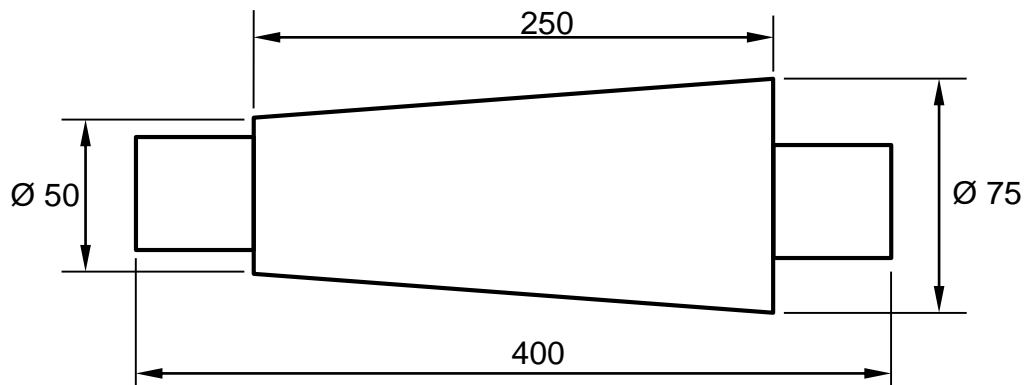
(1)

11.4 Name THREE methods of taper turning performed on a centre lathe.



(3)

11.5 FIGURE 4 shows a tapered shaft which is to be turned to the dimensions given.



**FIGURE 4**

11.5.1 Calculate the amount of tailstock set-over.

(2)

11.5.2 Calculate the included angle of the tapered portion in degrees and minutes.

(3)

11.6 A shaft with a diameter of 80 mm is to be machined on a lathe.



Determine the spindle speed of the lathe if the cutting speed is 30 m/min.

(3)


11.7 Give TWO reasons why clearance angles are necessary on different lathe-cutting tools.

(2)

**[20]**




**QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS**

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

12.2 Calculate the required indexing for an angle of 11° 15' Using the Brown and Sharpe dividing head.

<b>THE BROWN AND SHARPE DIVIDING HEAD (index plates)</b>						
Number of holes						
Plate 1	15	16	17	18	19	20
Plate 2	21	23	27	29	31	33
Plate 3	37	39	41	43	47	49

12.3 State THREE reasons for using nicked helical cutters.  (7)  
(3)

12.4 Name TWO reasons that may be the cause each of the following grinding faults:

12.4.1 Scratching of the work piece (2)

12.4.2 Chatter marks on the work piece (2)

12.4.3 Burning of the work piece  (2)  
**[20]**

**TOTAL SECTION B: 40**  
**GRAND TOTAL: 100**

(11022032)

## FORMULA SHEET

1.  $f = f_t \times T \times N$

2.  $S = \frac{\pi DN}{60}$

3.  $S = \pi DN$

4.  $\frac{40}{N}$

5.  $\frac{N}{9^\circ}$

6. Set-over =  $\frac{D-d}{2} \times \frac{\text{length of workpiece}}{\text{length of taper}}$

7.  $\tan \frac{\theta}{2} = \frac{X}{L}$

8. Leading angle =  $90^\circ - (\text{helix angle} + \text{clearance angle})$

9. Following angle =  $90^\circ + (\text{helix angle} - \text{clearance angle})$

10. Lead = number of starts  $\times$  pitch