Candidates require drawing instruments.

Calculators may be used.

This question paper consists of 16 pages and a formula sheet.
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. SECTION A is COMPULSORY, but candidates have a choice between QUESTION 1.1 and QUESTION 1.2.

2. Answer ONLY TWO questions from SECTION B.

3. Read ALL the questions carefully.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Write neatly and legibly.
SECTION A (COMPULSORY)

QUESTION 1: OCCUPATIONAL SAFETY

NOTE: Answer ONLY QUESTION 1.1 or QUESTION 1.2.

1.1 Explain, in your own words, FIVE basic safety measures applicable to the use of pneumatic tools. [5]

OR

1.2 Explain in your own words:

1.2.1 TWO safety regulations which apply to the use of propelled and self-propelled vehicles in a mine [2]

1.2.2 THREE safety regulations which apply to lighting and the use of safety lamps in a mine [3]

QUESTION 2: COUPLINGS

FIGURE 1 below shows a sketch of a type of coupling. Give brief answers to the following questions on this type of coupling.

FIGURE 1

2.1 Give the name of this coupling. [1]

2.2 Briefly describe this coupling. [2]

2.3 Does this coupling fall in the group classification of rigid couplings? Write only Yes or No in the ANSWER BOOK and give a motivation for your answer. [1]

2.4 Give ONE reason for the use of this coupling. [1]
QUESTION 3: LIMITS AND FITS

3.1. Give ONE example of each of the following types of fit:
   3.1.1. Clearance fit
   3.1.2. Transition fit
   3.1.3. Interference fit

3.2. Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.2.1 - 3.2.5) in the ANSWER BOOK:
   3.2.1. Basic size is the same as nominal size.
   3.2.2. Allowance is the difference in size between a hole and a shaft.
   3.2.3. Tolerance is the fit which is on one side of the basic size only.
   3.2.4. The hole basis system is used when a hole is machined according to a fixed shaft size.
   3.2.5. An interference fit is a fit in which a shaft could be larger or smaller than the hole.

QUESTION 4: BEARINGS

4.1. Identify the plain bearings numbered in FIGURE 2 below. Write the answer next to the number (4.1.1 - 4.1.4) in the ANSWER BOOK.

FIGURE 2
4.2 Explain THREE points to consider when cutting oil holes and oil grooves in plain bearings.

5.1 Explain, in your own words, the lubricating action of a siphon with lubricating devices, by referring to the terms siphon, gravity, wick.

5.2 Name FOUR types of shut-off valves.

6.1 State FOUR important guidelines to follow for the proper fitting of o-rings and seals in hydraulic systems.

6.2 State FOUR advantages of using thermo-plastic and thermo-setting plastic pipes.

7.1 Explain, in your own words, the function of a stuffing box assembly in centrifugal and reciprocating pumps.

7.2 FIGURE 3 below shows a sketch of a centrifugal pump. Name the FOUR numbered parts of the pump. Write the answer next to the numbers (7.2.1 – 7.2.4) in the ANSWER BOOK.

FIGURE 3
QUESTION 8: COMPRESSORS.

Explain the function of each of the following compressor components:

8.1. After-cooler

8.2. Water separator

8.3. Start-and-stop control switch

(2)

QUESTION 9: V-BELT, GEAR AND CHAIN DRIVES

9.1. Give THREE examples of the use of belt drives in the manufacturing and engineering industry.

(3)

9.2. Name THREE advantages that belt drives have over chain drives.

(3)

9.3. Explain, in your own words, THREE safety measures to be observed when maintaining belt drives.

(3)

TOTAL SECTION A: 89
SECTION B

NOTE: Answer only TWO questions from this section.

QUESTION 18: HYDRAULICS AND PNEUMATICS

10.1 Give TWO uses of a pneumatic motor in the manufacturing and engineering industry. (2)

10.2 Name the numbered parts as shown in FIGURE 4 below. Write the answer next to the numbers (10.2.1 – 10.2.4) in the ANSWER BOOK.

![FIGURE 4](image)

10.3 Give the THREE main functions of valves in a hydraulic flow system. (3)

10.4 Name TWO components in a power hydraulic unit of a hydraulic system. (2)

10.5 Name the numbered parts of the hydraulic reservoir as shown in FIGURE 5 below. Write the answer next to the numbers (10.5.1 – 10.5.4) in the ANSWER BOOK.

![FIGURE 5](image)
10.8 Make neat, freehand sketches of the symbols representing each of the following hydraulic components:

10.8.1 Hydraulic motor

10.8.2 Shut-off valve

10.8.3 Accumulator

10.8.4 Pressure gauge

10.8.5 Pump

AND/OR

QUESTION 11: CENTRE LATHES

11.1 On which part of the lathe would each of the following attachments be mounted?

11.1.1 Fixed steady

11.1.2 Travelling steady

11.2 A spindle needs to be turned according to the dimensions given below in FIGURE 6.

![FIGURE 6](image)

Calculate each of the following:

11.2.1 The amount of tailstock set-over

11.2.2 The included angle of the tapered portion (in degrees and minutes)

11.3 Calculate the time taken in minutes and seconds to take one cut over a length of 250 mm if the automatic feed of the cutting tool is 0.5 mm/revolution. The spindle speed is 190 rpm.
11.1 Calculate the helix angle of a three-start square thread with an outside diameter of 40 mm and a pitch of 8 mm.

11.5 Explain, in your own words, each of the following terms applicable to CNC machining:

11.5.1 Incremental programming
11.5.2 Absolute programming
11.5.3 G-Codes
11.5.4 M-Codes

11.8 Explain, in your own words, FOUR advantages of the use of mandrels on a centre lathe.

ANDIOR

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 Identify the milling processes shown in FIGURE 7 below. Write the answer next to the question number (12.1.1 - 12.1.3) in the ANSWER BOOK.

FIGURE 7

12.2 Name FOUR methods of indexing on a milling machine.

12.3 State THREE possible factors which cause the scratching of the work piece when surface grinding is done.

12.4 Calculate the cutting speed of the cutter in meters per minute when using a cutter of 35 mm in diameter at a speed of 350 revolutions per minute.
12.6 State FOUR advantages of using milling cutters with coarse teeth.

12.8 Give THREE reasons why it is more desirable to use a small diameter milling cutter.

TOTAL SECTION B: 40

GRAND TOTAL: 160
FITTING AND MACHINING THEORY N2

FORMULA SHEET

\( f = A \times Y \times V \)

\( s = \frac{a_{0.8}}{60} \)

\( s = a_{0.8} \)

\( 3 \bar{X} \)

\( N \times \frac{3}{24} \)

\( \frac{X}{Y} = \frac{\text{length of workpiece}}{\text{length of taper}} \)

\( \tan \frac{P}{Z} = \frac{X}{Z} \)

90° = (Helix angle + Clearance angle)
90° = (Flute angle - Clearance angle)

Length = No. of starts \times pitch