

2501/206
TOOL ROOM PROCESSES
TECHNOLOGY II AND METROLOGY
June/July 2023
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN MECHANICAL ENGINEERING
(PRODUCTION OPTION)

MODULE II

TOOL ROOM PROCESSES TECHNOLOGY II AND METROLOGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical tables / Scientific calculator;

Drawing instruments.

This paper consists of EIGHT questions in TWO sections; A and B.

Answer any FIVE questions taking at least TWO questions from each section.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: TOOL ROOM PROCESSES II

Answer at least **TWO** questions from this section.

1. (a) State:
- (i) **two** advantages of boring over drilling.
 - (ii) **two** operations that can be performed on a horizontal boring machine. (4 marks)
- (b) With the aid of a sketch, explain the operation of a table type horizontal boring machine. (7 marks)
- (c) Illustrate an external surface broaching operation. (4 marks)
- (d) A 30 mm long piece of mild steel has a bore of ϕ 40.32 mm, which is to be finish broached to ϕ 40.82^{+0.02} mm. Take $t = 0.025$ mm, $K = 5000$ N, $S=5$ and number of cutting teeth = 3.
Determine:
- (i) the length of the cutting portion of the broach;
 - (ii) the force required to pull the broach through the work. (5 marks)
2. (a) (i) List **three** reasons for gear finishing operations.
- (ii) With the aid of a sketch, describe burnishing as a gear finishing process. (9 marks)
- (b) With the aid of sketches, describe gear hobbing as a gear manufacturing method. (11 marks)
3. (a) (i) State **two** applications of ultrasonic machining process.
- (ii) With the aid of a diagram, explain the operation principle of ultrasonic machine. (11 marks)
- (b) With the aid of a sketch, describe the procedure for milling a constant rise cam on a dividing head. (9 marks)

4. (a) Differentiate between blanking and punching in press tool work. (3 marks)
- (b) With the aid of a sketch, describe the rack and pinion press drive. (4 marks)
- (c) (i) Illustrate crater and flank wears on a single point cutting tool.
- (ii) A tool gave a life span of 3 hours between re-grinds while operating with rough cut on mild steel at 20 m/min. Estimate the life of this tool on similar cuts at a speed of 30 m/min.
Take $n = \frac{1}{8}$. (8 marks)
- (d) With the aid of a sketch, explain the internal centreless grinding process. (5 marks)

SECTION B: METROLOGY

Answer at least **TWO** questions from this section.

5. (a) Explain the role of standards room in a factory. (3 marks)
- (b) (i) List **three** precautions to be taken to conserve the accuracy of slip gauges.
- (ii) Table 1 shows a set of 56 pieces of slip gauges. Outline the procedure for building the slip gauges to give each of the following dimensions:
- (I) 49.3825 mm;
- (II) 77.3215 mm. (9 marks)

Table 1

No.	No. of pieces	Size range	Increment
1	1	1.0005 mm	-
2	9	1.00 - 1.009 mm	0.001 mm
3	9	1.01 - 1.09 mm	0.01 mm
4	9	1.0 - 1.9 mm	0.1 mm
5	25	1 - 25 mm	1.0 mm
6	3	25 - 75 mm	25 mm

- (c) (i) Describe combination bars as used in measurements.
- (ii) State **two** applications of combination bars. (4 marks)

(d) Explain each of the geometric features shown in figure 1.

(4 marks)

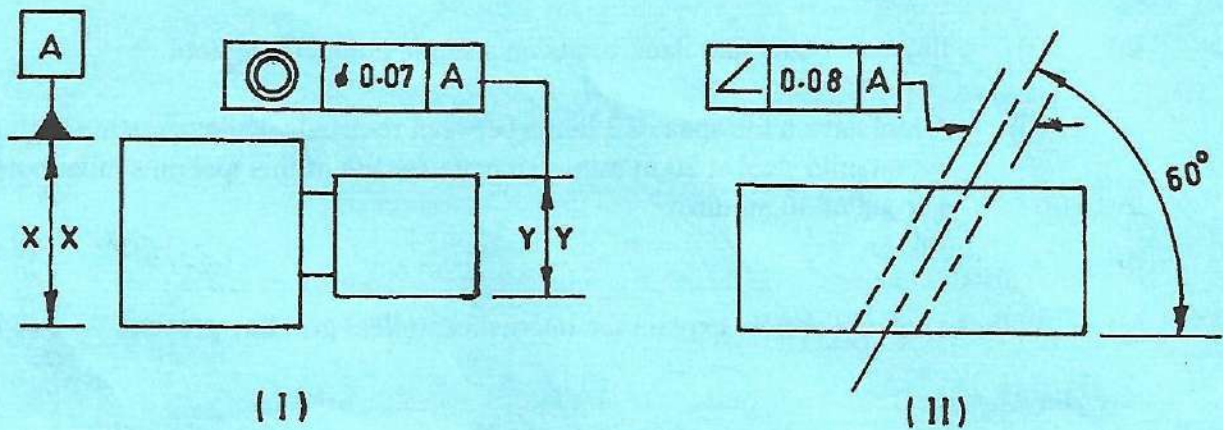


Fig.1

6. (a) Explain kinematic principles applied on each of the following:

(i) moving jaw of a vernier caliper;

(ii) drilling machine spindle.

(4 marks)

(b) With the aid of a sketch, explain the principle of operation of the Eden-Rolt "millionth" comparator. (11 marks)

(c) (i) Define statistical quality control.

(ii) Differentiate between measurement by attributes and measurement by variables in statistical quality control. (5 marks)

7. (a) Explain the BS 3730 requirements on the nature of each of the following, for the determination of departure from roundness:

(i) stylus instruments;

(ii) stylus for the instruments.

(4 marks)

(b) Explain each of the following with regard to assessment of roundness errors:

(i) Least Square Centre (LSC);

(ii) Minimum Zone Centre (MZC).

(4 marks)

- (c) With the aid of a sketch, describe the construction features and the operation of a clinometer. (12 marks)
8. (a) Differentiate between each of the following pairs of screw threads elements:
- (i) lead and pitch;
 - (ii) major diameter and effective diameter. (4 marks)
- (b) Describe each of the following screw thread call ups:
- (i) M18 - 6g;
 - (ii) M28 - 4h. (4 marks)
- (c) With the aid of sketches, describe the measurement of flank angle of a screw thread, using a microscope. (8 marks)
- (d) Illustrate the set-up for testing a lathe machine bed for level and wind. (4 marks)

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