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**WORKSHOP TECHNOLOGY, MATERIALS
AND METALLURGY**

June / July 2023

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN MECHANICAL ENGINEERING
(PLANT OPTION)**

**DIPLOMA IN AUTOMOTIVE ENGINEERING
DIPLOMA IN CONSTRUCTION PLANT ENGINEERING**

MODULE I

WORKSHOP TECHNOLOGY, MATERIALS AND METALLURGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Drawing instruments.

This paper consists of TWO sections; A and B.

Answer FIVE questions taking THREE questions from section A and TWO questions from Section B.

Maximum marks for each part of a question are as 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: WORKSHOP TECHNOLOGY

Answer any **THREE** questions from this section.

1. (a) Describe the procedure of performing the following finishing processes:
- (i) lacquering;
 - (ii) blueing.
- (4 marks)
- (b) Illustrate a reading of 10.67 mm on a metric micrometer scale. (8 marks)
- (c) Using sketches, explain the following limits and fits and state an example of their applications in engineering:
- (i) clearance fit;
 - (ii) transition fit.
- (8 marks)
2. (a) List **three** factors to be considered when selecting a suitable cutting fluid. (3 marks)
- (b) Explain the following tool angles:
- (i) clearance angle;
 - (ii) rake angle.
- (4 marks)
- (c) Describe a procedure for using faceplate on a lathe machine. (4 marks)
- (d) Using illustrations, explain the following milling operations:
- (i) slab milling;
 - (ii) face milling;
 - (iii) angular milling.
- (9 marks)

3. (a) Explain the principle of gas cutting. (3 marks)
- (b) Illustrate the following edge preparations to produce arc welding butt joints:
- (i) single vee;
 - (ii) double vee.
- (4 marks)
- (c) With the aid of a diagram, describe a procedure to carry out gas cutting on a piece of mild steel plate. Assume its thickness is within standard range. (8 marks)
- (d) Describe the manufacture of cast iron. (5 marks)
4. (a) State **three** functions of preventive maintenance. (3 marks)
- (b) Explain the following elements of preventive maintenance:
- (i) inspection;
 - (ii) calibration;
 - (iii) testing.
- (6 marks)
- (c) (i) Sketch the following sheet metalwork tools and state their use:
- (I) pick iron;
 - (II) creasing iron.
- (ii) The sheet metal in **figure 1** is made of mild steel. The workpiece has to undergo a beading process on one end. With the aid of sketches, outline a procedure of forming the bead on one side.

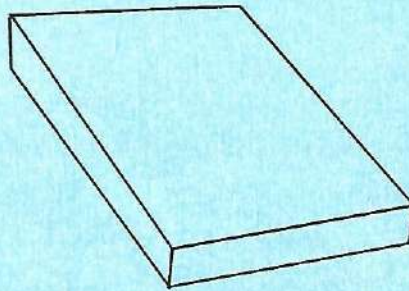


Figure 1.

(11 marks)

SECTION B: MATERIALS AND METALLURGY

Answer any **TWO** questions from this section.

5. (a) Define the following mechanical properties of metals:
- (i) hardness;
 - (ii) ductility;
 - (iii) brittleness;
 - (iv) malleability;
 - (v) weldability.
- (5 marks)
- (b) Describe the manufacturing of the following nonferrous metals:
- (i) aluminium;
 - (ii) copper.
- (7 marks)
- (c) Describe the following forms of supply of metals:
- (i) plates;
 - (ii) tubes;
 - (iii) blooms;
 - (iv) billets.
- (8 marks)
6. (a) State the carbon content and uses of the following types of carbon steels:
- (i) low-carbon steel;
 - (ii) mild steel;
 - (iii) medium-carbon steel;
 - (iv) high carbon steel.
- (8 marks)
- (b) (i) State **three** types of cast iron.
- (ii) Describe effects of the following elements on cast iron:
- (I) carbon;
 - (II) silicon;
 - (III) phosphorus.
- (12 marks)

7. (a) State any **three** properties of bearing materials. (3 marks)
- (b) Describe the following types of stainless steels and in each case state one application:
- (i) ferritic stainless steel;
 - (ii) austenitic stainless steel.
- (8 marks)
- (c) Illustrate the following crystal structure for metallic elements:
- (i) body centred cubic structure;
 - (ii) face centred cubic structure;
 - (iii) hexagon close-packed structure.
- (9 marks)

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