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**WORKSHOP TECHNOLOGY,
MATERIALS AND METALLURGY**

June/July 2016

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN MECHANICAL ENGINEERING
(PLANT OPTION, CONSTRUCTION PLANT OPTION)
DIPLOMA IN AUTOMOTIVE 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 any THREE questions from section A and any TWO questions from section B.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

This paper consists of 3 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 (60 marks)

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



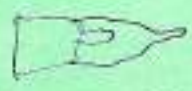
1. ✓
- (a) Define the following terms as used in metal working processes:
 (i) hot working;
 (ii) cold working. *ductility & hardness don't change* (2 marks)
- (b) List four advantages of a "hot worked" metal product. *high production rate, minimal loss of fracture, high reduction possible* (4 marks)
- (c) With the aid of a sketch, illustrate the use of top and bottom chisels to cut a metal bar. (5 marks)
- (d) With the aid of a diagram, illustrate the following mills:
 (i) four-high rolling mill;
 (ii) two-high rolling mill. (9 marks)

- ✓ 2. ✓
- (a) (i) List three types of files classification according to the cut of the teeth. (5 marks)
 (ii) Using a sketch, illustrate the following:
 - single cut file;
 - double cut file. (5 marks)
- (b) Outline the procedure of tapping a blind hole. *(1) select the material to be tapped, (2) select the tap, (3) start tapping, (4) stop tapping, (5) clean the hole* (5 marks)
- (c) (i) Explain three classifications of fires. *(1) Class A - combustible materials, (2) Class B - flammable liquids, (3) Class C - energized electrical equipment, (4) Class D - combustible metals (by powder)* (5 marks)
 (ii) State the applicable fire extinguisher for each type of fire in (i) above. (10 marks)

3. ✓
- (a) (i) Sketch a labelled diagram of an outside micrometer. (7 marks)
 (ii) Illustrate a reading of 7.22 mm on an outside micrometer. (7 marks)
- (b) (i) With the aid of sketches, explain the two bases of limit systems;
 (ii) Illustrate three types of fits giving a typical application for each fit. (13 marks)

4. ✓
- (a) (i) Define the term 'brazing'.
 (ii) Outline the procedure of brazing two pieces of metal. (4 marks)



- ✓ (b) Sketch the following gas welding flames and state an application for each.
 (i) neutral flame; *used for fusion & casting - C.I. & steel properties*
 (ii) oxidising flame; *high temp & for cutting metal*
 (iii) carburising flame. *loss of O₂ & temp. drop* (6 marks)



- (c) Illustrate the following types of weld joints and state an application for each:
 (i) double U-butt;
 (ii) double V-butt;
 (iii) fillet weld;
 (iv) spot weld. *A result of electrical resistance* (10 marks)

SECTION B: MATERIALS AND METALLURGY (40 marks)

Answer any TWO questions from this section.

5. (a) State three properties of a good bearing material. *tough to withstand shock loads - Be strong enough to support dead weight. Resist wear and abrasion.* (3 marks)
- (b) (i) Define the term "heat treatment". *To heat metal to softness & then cool it down.*
- (ii) State four reasons why heat treatment is done on metals. *- Reduce stress & strain, improve properties, improve machinability, improve appearance.*
- (iii) Explain the following heat treatment processes stating an application for each: (17 marks)
- (I) case hardening;
 - (II) nitriding;
 - (III) tempering. *→ Done after hardening to remove brittleness & inc hardness*
6. (a) (i) Explain the difference between ferrous metals and non-ferrous metals stating an example for each.
- (ii) List four types of plain cast irons. *- Pearlitic, white, grey, malleable.* (5 marks)
- (b) Explain the following types of steels and state an application for each: (6 marks)
- (i) heat resisting steels;
 - (ii) stainless steels;
 - (iii) high speed steels.
- (c) Illustrate the following space lattices stating two examples for each: (9 marks)
- (i) body centred cubic; *Body* 
 - (ii) face centred cubic; *face* 
 - (iii) close packed hexagonal.
7. (a) Explain the effect of the following elements in cast iron: *remove carbon from cast iron.*
- (i) silicon; *form iron silicide which prevents formation of graphite hence inc brittleness*
 - (ii) sulphur; *prevent slight brittleness of CI formed by sulphur by forming MnS*
 - (iii) manganese;
 - (iv) phosphorous. (4 marks)
- (b) (i) State the purpose of flux in a blast furnace; *To break down silicate formation*
- (ii) With the aid of a sketch, describe the operation of the direct arc electric furnace. (16 marks)

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