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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.



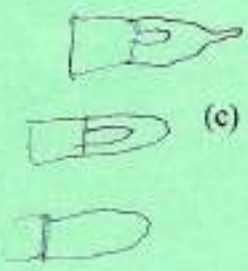
1. ✓ (a) Define the following terms as used in metal working processes:
- (i) hot working; ✓
  - (ii) cold working. ✓
- ductility & hardness don't change* (2 marks)
- (b) List four advantages of a "hot worked" metal product. ✓
- high production rate*
  - minimal loss of fracture*
  - high reduction possible*
- (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. ✓
- (ii) Using a sketch, illustrate the following:
- single cut file; ✓
  - double cut file. ✓
- (5 marks)
- (b) Outline the procedure of tapping a blind hole. ✓
- (5 marks)
- (c) (i) Explain three classifications of fires. ✓
- Class A - Combustible materials (wood)*
  - Class B - Flammable liquids (gasoline)*
  - Class C - Energizing equipment (by powder)*
  - Class D - Combustible metals*
- (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. ✓
- (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 most carbon steels - C.I. & non-ferrous properties.*
  - (ii) oxidising flame; ✓ *high temp & for cutting metal.*
  - (iii) carburising flame. ✓ *loss of O<sub>2</sub> & temp. drops*
- (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 homogeneity*
- (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 prevent 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 surface tension*
- (ii) With the aid of a sketch, describe the operation of the direct arc electric furnace. (16 marks)

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