THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

092 **WORKSHOP TECHNOLOGY**

(For Both School and Private Candidates)

Time : 3 Hours **ANSWERS** **Year : 2022**

Instructions

1. This paper consists of sections A, B and C.
2. Answer all questions in section A and B and **three (3)** question from section C.
3. Non-programmable calculators may be used.
4. Communication devices and any unauthorised materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

1. (i) What gives the possibility of cutting grey cast iron without using cutting fluid?
   A. The presence of pearlite
   B. The presence of free ferrite
   C. The presence of iron carbide
   D. The presence of graphite
   E. The presence of sulphur

   Correct answer: D. The presence of graphite
   Reason: Graphite in grey cast iron acts as a solid lubricant, making it possible to cut without cutting fluid.

   (ii) Which of the following is the result of hot rolling process?
   A. Improvement of surface finish
   B. Increased density of metal
   C. Improvement of ductility of metal
   D. Improvement of fusibility
   E. Increased dimensional accuracy

   Correct answer: C. Improvement of ductility of metal
   Reason: Hot rolling refines grain structure, reduces porosity, and increases ductility.

   (iii) Suppose you are working in a heat treatment workshop and a steel shaft with soft core and hard outside skin is required. Which process will you use to modify mild steel to suit the purpose?
   A. Normalizing
   B. Carburizing
   C. Hardening
   D. Tempering
   E. Annealing

   Correct answer: B. Carburizing
   Reason: Carburizing adds carbon to the surface of mild steel to produce a hard outer skin while the core remains soft.

   (iv) Which method of material testing suitable for determining the deformation of material at constant load below its yield strength?
   A. Creep testing

B. Tensile testing

C. Compression testing

D. Fatigue testing

E. Hardness testing

Correct answer: A. Creep testing

Reason: Creep testing measures the slow, permanent deformation of a material under constant load over time.

(v) What is the product represented by letter X in Figure 1?

A. Blister steel

B. Tool steel

C. Shear steel

D. Crucible steel

E. General purpose steel

Correct answer: E. General purpose steel

Reason: The diagram shows pig iron refined in basic oxygen or open hearth furnace producing general purpose steel.

(vi) What is the function of silicon in cast iron?

A. To promote graphite nodule formation and improve ductility of cast iron.

B. To promote graphite flake formation and increase fluidity of the molten metal.

C. To promote graphite nodule formation and increase fluidity of the molten metal.

D. To increase fluidity of the molten metal and improve the ductility of cast iron.

Correct answer: B. To promote graphite flake formation and increase fluidity of the molten metal

Reason: Silicon promotes graphitization in cast iron and enhances fluidity during casting.

(vii) Which of the following processes is used to make bottles from thermoplastic materials?

A. Compression molding

B. Extrusion

C. Injection molding

D. Blow molding

E. Transfer molding

Correct answer: D. Blow molding

Reason: Blow molding is the most common process for manufacturing hollow plastic products such as bottles.

(viii) Suppose you are a technician working in the factory which produces cutting tools & drills, saws and milling cutters, what type of material will you order for that purpose?

A. High speed steel

B. High carbon steel

C. Cast iron

D. Mild steel

E. Silver steel

Correct answer: A. High speed steel

Reason: High speed steel retains hardness at high temperatures, making it ideal for cutting tools.

(ix) A candidate used a center punch to mark a hole on the cemented carbide surface but failed. What could be the reason for the failure?

A. The surface was too slippery

B. The surface was casted

C. The surface was too big in size

D. The center punch blunt

E. The surface was harder than the center punch

Correct answer: E. The surface was harder than the center punch

Reason: Cemented carbide is very hard, harder than the punch, causing failure.

(x) Which term denotes a system of assembling a number of unit components taken at random from stock so as to build up a complete mechanism or machine?

A. Tolerance

B. Allowance

C. Interchangeability

D. Serviceability

E. Deviation

Correct answer: C. Interchangeability

Reason: Interchangeability ensures that manufactured parts can be selected at random and still fit correctly during assembly.

2. (a) Classify metal heating furnace according to the fuel used.

Metal heating furnaces can be classified into:

- Coal-fired furnaces, which use coal as the primary source of fuel.
- Oil-fired furnaces, which use fuel oil for heating.
- Gas-fired furnaces, which use natural gas or producer gas.
- Electric furnaces, which use electricity as the source of heat.

(b) Mention two instruments used to measure furnace temperatures.

The two instruments are: Thermocouples and Optical pyrometers.

3. Explain why cast iron is extensively used in industries for making various machine parts.

Cast iron is extensively used because it has excellent castability, allowing it to be easily molded into complex shapes.

It is also relatively cheap compared to other metals, making it economical for mass production.

Additionally, it has good wear resistance and vibration damping properties, making it suitable for heavy machinery.

4. (a) Explain three factors they will consider in order to select appropriate materials for a particular work in mechanical engineering.

The mechanical properties of the material such as strength, hardness, and toughness will be considered to ensure the material can withstand applied loads.

The environmental conditions such as corrosion, temperature, and moisture resistance will also be important to prevent material failure.

The cost and availability of the material will also be considered to balance performance with economic feasibility.

(b) Classify the engineering materials into two main groups.

The two main groups are Metallic materials (e.g., steel, copper, aluminum) and Non-metallic materials (e.g., plastics, ceramics, rubber).

5. (a) What alloys are formed by the combination of the following metal?

(i) 60% tin, 10% antimony, 1.5% copper and 28.5% lead forms Bearing metal (also called Babbitt metal).

(ii) 88% copper, 10% tin and 2% zinc forms Bronze.

(iii) 65% tin and 35% lead forms Soft solder.

(b) What type of alloying element is required in each of the following cases?

(i) Alloying with steel to obtain material for making excavator bucket for earth moving machine requires Chromium for hardness and wear resistance.

(ii) Alloying with steel to make it cut other metals at high temperatures requires Tungsten or Molybdenum for hot hardness.

6. (a) Explain tricolour codes indicated in metal identified by blue, yellow and red colour.

Blue colour indicates the presence of carbon steel.
Yellow colour indicates the presence of brass material.
Red colour indicates the presence of copper material.

(b) Decide the correct appearance colours of the high-speed steel and copper materials.

High-speed steel appears Greyish silver.
Copper appears Reddish brown.

7. Explain five advantages of using chemical cutting fluids.

Chemical cutting fluids reduce friction between the cutting tool and workpiece, prolonging tool life.

They improve the surface finish of the machined part.

They help to remove heat from the cutting zone, preventing overheating.

They flush away chips from the cutting area, preventing re-cutting.

They reduce power consumption by lowering cutting forces.

8. (a) Explain the three methods used for heating steel during case hardening.

The three methods are: Carburizing, Cyaniding, and Nitriding.

(b) Give the advantage of using air as a quenching medium in heat treatment.

Air cooling prevents cracking and distortion of steel, providing a more uniform hardness.

9. (a) Explain three techniques in assembling the components if the hole and the shaft are made with interference fit.

One technique is Shrink fitting, where the hole is heated to expand and the shaft is inserted.

Another technique is Force fitting, where the shaft is pressed into the hole using hydraulic pressure.

A third technique is Cooling fitting, where the shaft is cooled (e.g., with liquid nitrogen) before inserting into the hole.

(b) State the uses of plug and snap gauges.

Plug gauges are used to check the accuracy of holes (internal dimensions).

Snap gauges are used to check the external dimensions of shafts.

10. Explain the behavior of a metal having the following properties:

(a) Toughness – Ability of a metal to absorb energy and withstand shock without fracturing.

(b) Ductility – Ability of a metal to be drawn into wires without breaking.

(c) Malleability – Ability of a metal to be hammered or rolled into thin sheets.

(d) Brittleness – Tendency of a metal to break or shatter without significant deformation.

(e) Elasticity – Ability of a metal to regain its original shape after removal of applied force.