THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

090 MECHANICAL ENGINEERING

Time: 2:30 Hours **ANSWERS** **Year: 2021**

Instructions

1. This paper consists of Section **A, B** and **C** with a total of **ten (10)** questions
2. Answer **al**l questions.
3. Section **A** and **C** carry **fifteen (15)** marks each and section **B** carries **seventy (70)** marks
4. Cellular phones and unauthorized materials are not allowed in the assessment room
5. Write your **Assessment Number** at the top right-hand corner of every page.

FOR ASSESSOR'S USE ONLY

QUESTION NUMBER	SCORE	ASSESSOR'S INITIALS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

SECTION A (15 Marks)

Answer all questions in this section.

1. Choose the correct answer from the given alternatives and write its letter in the box provided.

(i) Which type of filing technique should be used for a good surface finish of the metal product?

A. Single cut filing and double cut filing

B. Cross filing and draw filing

C. Draw filing and double cut filing

D. Single cut filing and cross filing

Draw filing, where the file is pulled along the workpiece length, produces a smooth, polished surface finish.

Answer: B

(ii) Which of the following is an unsafe working habit that you should observe during material handling?

A. Carrying of too heavy load and tuck your chin in

B. Grasping of the load firmly to the body and lifting

C. Handling with leather sleeves and carrying too heavy load

D. Wearing of PPE and lifting improperly the load

Carrying too heavy a load and tucking the chin in risks strain and poor posture, making it unsafe.

Answer: A

(iii) How is the trained person having the ability to make technical drawings and write reports called?

A. An Engineer

B. A Technician

C. A Craft person

D. An Artisan

An engineer is trained to create technical drawings and write detailed reports for engineering projects.

Answer: A

(iv) What is the term used to describe the profession of applying the scientific principles in designing, developing and producing components?

A. Science

B. Technical

C. Engineering

D. Mechanical

Engineering applies scientific principles to design, develop, and produce components and systems.

Answer: C

(v) Everyone working in the workshop is advised to put on PPEs when executing his/her job. What does PPEs stand for?

A. Personal Production Equipment

B. Personal Preventive Equipment

C. Personal Protective Equipment

D. Personal Permissible Equipment

PPE stands for Personal Protective Equipment, used to ensure safety in hazardous environments.

Answer: C

(vi) Most of machine cases and complicated heavy weight machine bases are made with cast iron. Which property makes this type of iron material most preferable to be used?

A. Machinability

B. Malleability

C. Fluidity

D. Workability

Cast iron’s fluidity when molten allows it to be easily cast into complex shapes for machine bases.

Answer: C

(vii) During working process of selecting a steel material for a certain job, it was observed that the material has higher amount of residue and coercive magnetic force. Which element causes the steel used to have this property?

A. Chromium

B. Vanadium

C. Manganese

D. Cobalt

Cobalt increases residual magnetism and coercive force in steel, enhancing magnetic properties.

Answer: D

(viii) Which type of fire extinguishers would you use to extinguish the fire resulted from electrical fault in the school workshop?

A. Dry powder, foam and water

B. Carbon dioxide, dry powder and sand

C. Carbon dioxide, foam and water

D. Carbon dioxide, water and sand

Carbon dioxide, dry powder, and sand are safe for electrical fires; water and foam conduct electricity.

Answer: B

(ix) Oxy-acetylene flame is obtained after mixing oxygen gas with acetylene gas. What is the function of oxygen gas in that flame?

A. To burn the acetylene gas

B. To reduce smoke during burning

C. To support combustion

D. To reduce flame intensity

Oxygen supports combustion by providing the necessary oxidant for acetylene to burn effectively.

Answer: C

(x) A mechanist was performing a filing on metal workpieces A and B. The result shows that workpiece A causes much pinning to the file than workpiece B. What conclusion can you draw from that observation?

A. Workpiece A is harder than workpiece B

B. Workpiece A is stronger than workpiece B

C. Workpiece A is softer than workpiece B

D. Workpiece A is tougher than workpiece B

Pinning (metal sticking to the file) occurs with softer materials, indicating workpiece A is softer.

Answer: C

2. Match the properties of engineering materials in List A with the type of material in List B by writing a letter of the correct response to the corresponding item number.

List A

(i) It is an alloy of copper and zinc which contains small amounts of lead, tin or aluminium

(ii) It is an aluminium alloy

(iii) It has higher ability to resist corrosion

(iv) It is steel with carbon percentage from 0.8 to 1.5

(v) It is an alloy of copper and tin

List B

A. Medium carbon steel

B. High carbon steel

C. Brass

D. Non-ferrous metal

E. Security

F. Bronze

G. Duralumin

(i) Copper-zinc alloy with lead/tin/aluminium → C (Brass)

(ii) Aluminium alloy → G (Duralumin)

(iii) High corrosion resistance → D (Non-ferrous metal)

(iv) Steel with 0.8-1.5% carbon → B (High carbon steel)

(v) Copper-tin alloy → F (Bronze)

SECTION B (70 Marks)

Answer all questions from this section.

3. (a) A school storekeeper needs to buy tools and equipment for practical work. Which three measuring and checking tools would you advise him to buy for daily workshop activities?

(i) Vernier caliper

(ii) Micrometer

(iii) Try square

(b) If you were asked to add other marking-out equipment out of the purchased tools in (a), which other seven tools would you buy to enable the process of marking to proceed?

(i) Scriber

(ii) Centre punch

(iii) Divider

(iv) Surface plate

(v) Marking blue

(vi) Steel rule

(vii) Combination set

4. (a) Fusion and non-fusion are two types of welding processes used to join metals. With two examples in each, describe these two phenomena.

(i) Fusion welding: Melts base metals to form a joint. Examples:

Gas welding (oxy-acetylene)

Arc welding (shielded metal arc)

(ii) Non-fusion welding: Joins metals without melting base metals, using filler. Examples:

Brazing

Soldering

Answer:

(i) Fusion: Melts metals; Gas welding, Arc welding

(ii) Non-fusion: No melting; Brazing, Soldering

(b) Suppose you have finished welding the pieces of work and you want to close the workshop. Briefly explain five procedures you would follow in order to shut down a gas plant.

(i) Turn off acetylene valve on the torch.

(ii) Turn off oxygen valve on the torch.

(iii) Close both cylinder valves.

(iv) Open torch valves to release residual gas, then close them.

(v) Disconnect regulators and store equipment safely.

5. (a) Describe the five properties of bronze materials that differentiate it with other ferrous metals.

(i) High corrosion resistance, unlike ferrous metals.

(ii) Non-magnetic, unlike steel or iron.

(iii) Good thermal conductivity for heat dissipation.

(iv) Ductility, allowing shaping without cracking.

(v) Aesthetic bronze color, unlike ferrous metals' grey.

(b) Give five applications of non-ferrous metals and their alloys.

(i) Copper wiring for electrical conductivity.

(ii) Aluminium aircraft frames for lightweight strength.

(iii) Brass fittings for corrosion resistance.

(iv) Bronze statues for aesthetic durability.

(v) Tin coatings for food cans to prevent rust.

6. (a) Twist drill bit and reamer are the cutting tools used in machine shop having similar shape but differ in few aspects. Draw a neat sketch of twist drill bit and label the following parts: tang, shank, neck, flute, and angle of cut.

Text Description:

Cylindrical tool with spiral flutes.

Tang: Tapered end for drill chuck.

Shank: Cylindrical body held by chuck.

Neck: Transition between shank and flutes.

Flute: Spiral grooves for chip removal.

Angle of cut: Point angle (e.g., 118°) at cutting tip.

Answer: Sketch: Cylindrical drill with tang (tapered end), shank (body), neck (transition), flutes (spirals), angle of cut (point angle).

(b) What are the two criteria which make the drill bit differ to reamer as stated in (a)?

(i) Drill bit cuts new holes; reamer enlarges/finishes existing holes.

(ii) Drill bit has pointed tip; reamer has straight or slightly tapered edges.

(c) Reamer and drill bits, both of them have flutes. What are three functions of this part?

(i) Remove chips from the cutting area.

(ii) Allow coolant to reach cutting zone.

(iii) Reduce friction between tool and workpiece.

7. Accidents are bad luck events which cause injury to the people, damage machines, tools and equipment resulting into loss of productions. What are the five causes and prevention of accidents?

(a) Causes

(i) Lack of training in tool/machine use.

(ii) Faulty or unguarded machinery.

(iii) Poor workshop lighting.

(iv) Slippery floors from spills.

(v) Fatigue or distraction of workers.

(b) Preventions

(i) Provide comprehensive safety training.

(ii) Install and maintain machine guards.

(iii) Ensure adequate workshop lighting.

(iv) Clean spills immediately.

(v) Enforce breaks to reduce fatigue.

8. (a) How can you differentiate metals and non-metals as engineering materials is concerned? Give two points.

(i) Conductivity: Metals conduct heat/electricity; non-metals do not.

(ii) Malleability: Metals are malleable/ductile; non-metals are brittle.

Answer:

(i) Metals conduct; non-metals don't.

(ii) Metals malleable; non-metals brittle.

(b) Steel and cast iron are both ferrous metals. What is the difference between them?

(iii) Steel: Carbon content <2%, ductile, and machinable.

(iv) Cast iron: Carbon content >2%, brittle, and castable.

(c) Briefly explain the differences of the following impurities when added in the mild steel:

(v) Sulphur: Causes brittleness (hot shortness), reducing ductility.

(vi) Manganese: Increases strength and toughness, counteracts sulphur.

(vii) Phosphorus: Increases strength but causes cold shortness (brittleness at low temperatures).

9. A certain manufacturing company from abroad needs to invest in Tanzania. A top manager requested you to make presentation on categories of engineers and other technical experts required for the project and their job descriptions.

(a) Give two categories of engineers and five main activities of each.

(i) Category 1: Mechanical Engineer

Main activities:

Design mechanical systems and components.

Analyze performance of machinery.

Oversee manufacturing processes.

Conduct maintenance planning.

Ensure compliance with safety standards.

(ii) Category 2: Industrial Engineer

Main activities:

Optimize production workflows.

Manage supply chain logistics.

Implement quality control systems.

Analyze cost efficiency of processes.

Coordinate workforce and resources.

(b) What other three technical expertise needed and their roles out of the one mentioned in (a)?

(iii) Expert 1: Technician

Role function: Install, maintain, and repair machinery under engineer supervision.

(iv) Expert 2: Quality Control Inspector

Role function: Inspect products to ensure they meet standards and specifications.

(v) Expert 3: Safety Officer

Role function: Enforce safety regulations and conduct risk assessments.

SECTION C (15 Marks)

Answer all questions.

10. Electrode manufacturers usually provide some information with code number which identifies type of electrode and main features:

(a) Briefly describe two types of electrode based on melting point and their application.

(i) Consumable electrode: Melts to form weld pool (e.g., used in shielded metal arc welding for steel).

(ii) Non-consumable electrode: Does not melt, used to sustain arc (e.g., tungsten in TIG welding for precision welds).

(b) Give five pieces of information which are found on the electrode package (box).

(i) Electrode type (e.g., E6013).

(ii) Diameter of electrode.

(iii) Welding position (e.g., all positions).

(iv) Current type (AC/DC).

(v) Coating type (e.g., rutile).

(c) What is meant if electrode is marked with code number E6013 according to American Welding Society (AWS).

(i) E represents: Electrode for arc welding.

(ii) 60 represents: Tensile strength of 60,000 psi.

(iii) 1 represents: Welding in all positions.

(iv) 3 represents: Rutile coating, suitable for AC/DC.