THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

090 MECHANICAL ENGINEERING

Time: 2:30 Hours **ANSWERS** **Year: 2023**

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 types of chisels are used for chipping away materials from the workpiece?

A. Flat, round, square and diamond point

B. Flat, cross cut, diamond point and square

C. Flat, cross cut, half round and diamond point

D. Hollow, flat and pin chisel

Chisels for chipping include flat (general cutting), cross cut (grooves), half round (curved surfaces), and diamond point (fine work).

Answer: C

(ii) Which metals fall under ferrous metals group?

A. Steel, Copper and Tin

B. Pig iron, Brass and Cast iron

C. Pig iron, Steel and Cast-iron

D. Cast iron, Brass and Steel

Ferrous metals contain iron, including pig iron, steel, and cast iron. Copper, tin, and brass (copper-zinc alloy) are non-ferrous.

Answer: C

(iii) The tendency of materials to develop different characteristic behavior when subject to fluctuating or repeated loads is known as:

A. Fatigue

B. Resilience

C. Creep

D. Stiffness

Fatigue is the weakening of materials under repeated or fluctuating loads, leading to failure.

Answer: A

(iv) Drill bit is the cutting tool which facilitates the making of a hole in the workpiece. Which part passes chips during cutting operation?

A. Heel

B. Shank

C. Flute

D. Pitch

Flutes are spiral grooves on a drill bit that allow chips to exit the hole during drilling.

Answer: C

(v) Which material of hacksaw blade is appropriate for cutting a revolving or stationary workpiece?

A. High tungsten steel

B. High carbon steel

C. Carbide tool steel

D. High speed steel

High speed steel (HSS) is durable and heat-resistant, ideal for cutting both revolving and stationary workpieces.

Answer: D

(vi) Suppose you are assigned to cut the given metallic components: round bar with Ø20 mm, black pipe Ø25 mm and flat bar having thickness of 6 mm, which appropriate tool will you select for the job?

A. Power hacksaw machine

B. Hand hacksaw

C. Cold chisel

D. Shear machine

A hand hacksaw is suitable for manually cutting small components like a Ø20 mm bar, Ø25 mm pipe, and 6 mm flat bar.

Answer: B

(vii) What appropriate type of furnace is required to be installed first in order to make mass production of steel for industrial use?

A. Bessemer process

B. Open-hearth process

C. Steel making process

D. Manufacturing process

The open-hearth process is suitable for large-scale steel production due to its ability to produce high-quality steel in bulk.

Answer: B

(viii) Which set of elements are found in the process of producing pig iron by smelting iron ore in the blast furnace?

A. Magnesium, manganese, sulphur, chromium and carbon

B. Carbon, silicon, manganese, sulphur and phosphorus

C. Sulphur, phosphorus, manganese and magnesium

D. Chromium, carbon, sulphur, silicon and phosphorus

Pig iron contains carbon, silicon, manganese, sulphur, and phosphorus as impurities from the blast furnace process.

Answer: B

(ix) Which one of the following can be the uses of a divider?

A. Reading the arc, measuring and dividing the line

B. Dividing the arc, reading and transferring measurement

C. Transferring measurement and dividing the arc

D. Marking arcs, dividing a line and transferring dimensions

Dividers are used for marking arcs, dividing lines into equal parts, and transferring dimensions accurately.

Answer: D

(x) Why is it necessary to colour code the fire extinguisher?

A. For its quick identification and rust prevention

B. For preventing misuse and attractiveness

C. For inspection and reflectiveness

D. For quick identification and reflection

Colour coding allows quick identification of extinguisher type and reflects its purpose for emergency use.

Answer: D

2. Match the properties of engineering material in List A with the corresponding metallic element in List B by writing a letter of the correct response in the table provided.

List A

(i) It increases the elasticity, strength at high temperature and machinability of steel

(ii) It resists wear and corrosion, increases toughness and hardness of steel

(iii) It is toughened and strengthens steel, fatigue and wear resistant

(iv) It promotes hot shortness and weakens steel by making brittle

(v) It promotes cold shortness, increases strength and resists corrosion

List B

A. Vanadium

B. Manganese

C. Phosphorus

D. Molybdenum

E. Chromium

F. Carbon

G. Silicon

H. Sulphur

Answers.

(i) Elasticity, high-temperature strength, machinability → D (Molybdenum)

(ii) Wear/corrosion resistance, toughness, hardness → E (Chromium)

(iii) Toughens, strengthens, fatigue/wear resistant → B (Manganese)

(iv) Hot shortness, brittleness → H (Sulphur)

(v) Cold shortness, strength, corrosion resistance → C (Phosphorus)

SECTION B (70 Marks)

Answer all questions from this section.

3. A 60 mm × 50 mm × 8 mm mild steel bar is to be filed, hacksawed and drilled during workshop practice.

(a) Briefly explain six operational sequences in order to accomplish the work.

(i) Mark out dimensions on the steel bar using a scriber and ruler.

(ii) Secure the bar in a vice for stability.

(iii) File surfaces to remove burrs and achieve smoothness.

(iv) Hacksaw to cut the bar to the desired length or shape.

(v) Mark drilling points with a centre punch.

(vi) Drill holes using an appropriate drill bit and drilling machine.

(b) What are the four precautions to be taken into account during the work operation?

(i) Wear safety goggles to protect eyes from chips.

(ii) Ensure tools are sharp to avoid excessive force.

(iii) Check vice is tight to prevent workpiece movement.

(iv) Use cutting fluid during drilling to reduce heat.

4. Suppose you were assigned to do safety assessment in school workshop and you observe that there were many accidents caused by mechanical and human errors. Briefly explain five mechanical causes of accident and five human causes.

(a) Mechanical causes

(i) Faulty machine guards exposing moving parts.

(ii) Worn-out tools causing unexpected breakage.

(iii) Improperly maintained equipment leading to malfunctions.

(iv) Inadequate lighting reducing visibility.

(v) Slippery floors from oil spills causing falls.

(b) Human error causes

(i) Lack of training leading to improper tool use.

(ii) Not wearing personal protective equipment (PPE).

(iii) Fatigue reducing focus and coordination.

(iv) Ignoring safety protocols during operations.

(v) Distraction while operating machinery.

5. (a) The process of joining two metals using gas welding can be done either by fusion or non-fusion welding process. What makes these two processes differ from each other?

Fusion welding melts the base metals to form a joint, while non-fusion welding (e.g., brazing) joins metals using a filler material without melting the base metals.

Answer: Fusion: Melts base metals; Non-fusion: Uses filler, no melting.

(b) Briefly explain five procedures you will follow in order to shut down a gas plant after finishing welding activity.

(i) Turn off the acetylene valve on the torch.

(ii) Turn off the oxygen valve on the torch.

(iii) Close the cylinder valves for both gases.

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

(v) Disconnect regulators and store equipment safely.

6. (a) Give two advantages and two disadvantages of Direct Current Straight Polarity (DCSP) and Direct Current Reverse Polarity (DCRP) welding processes.

Advantages of Direct Current Straight Polarity (DCSP)

(i) Deeper penetration for thick materials.

(ii) Faster welding speed due to concentrated heat.

Disadvantages of Direct Current Straight Polarity (DCSP)

(i) Poor arc stability for thin materials.

(ii) Limited use for non-ferrous metals.

Advantages of Direct Current Reverse Polarity (DCRP)

(i) Better arc stability for thin materials.

(ii) Suitable for welding non-ferrous metals.

Disadvantages of Direct Current Reverse Polarity (DCRP)

(i) Shallower penetration for thick materials.

(ii) Higher electrode wear.

(b) With the help of well labelled sketch diagram, explain how you will connect your workpiece from arc welding power supply source to get a Direct Current Straight Polarity (DCSP).

Text Description:

Power supply with positive and negative terminals.

Electrode holder connected to negative terminal.

Workpiece connected to positive terminal via ground clamp.

Labelled: Power supply, Electrode (negative), Workpiece (positive), Welding arc.

Answer: Connect electrode to negative terminal, workpiece to positive terminal. Sketch: Electrode (negative) and workpiece (positive) linked to power supply, showing arc.

7. (a) Why is it important to establish safety and health programmes in industries? Give four benefits.

(i) Reduces workplace accidents and injuries.

(ii) Improves employee morale and productivity.

(iii) Lowers medical and compensation costs.

(iv) Ensures compliance with safety regulations.

(b) What are the six personal safety precautions you should practice in order to avoid injuries in machine shop?

(i) Wear safety goggles to protect eyes.

(ii) Use gloves to handle sharp materials.

(iii) Wear steel-toed boots for foot protection.

(iv) Tie back long hair to avoid entanglement.

(v) Avoid loose clothing near machines.

(vi) Follow machine operating instructions.

8. (a) Briefly explain the term ‘marking out’ as used in bench workshop.

Marking out is the process of transferring measurements and shapes onto a workpiece to guide cutting, drilling, or shaping.

Answer: Transferring measurements/shapes to guide operations.

(b) You have been assigned to mark a steel plate to be drilled. Give eight operations procedure you will follow to accomplish the task.

(i) Clean the steel plate surface.

(ii) Measure and mark dimensions using a ruler.

(iii) Use a scriber to draw lines accurately.

(iv) Mark hole centres with a centre punch.

(v) Verify measurements with a square.

(vi) Apply marking blue for visibility.

(vii) Double-check alignment and spacing.

(viii) Secure plate for drilling preparation.

9. (a) Briefly explain the term ‘fusion welding’ as applied in gas welding process.

Fusion welding involves melting the edges of base metals to form a joint, often with a filler material, using a gas flame.

Answer: Melts base metals to join, often with filler, using gas flame.

(b) What are the four advantages and four disadvantages of fusion welding?

Advantages of fusion welding

(i) Strong, permanent joints.

(ii) Suitable for various metals.

(iii) No need for mechanical fasteners.

(iv) Can join complex shapes.

Disadvantages of fusion welding

(i) High heat may distort workpiece.

(ii) Requires skilled operators.

(iii) Produces hazardous fumes.

(iv) Slow process for thick materials.

SECTION C (15 Marks)

Answer all questions from this section.

10. (a) Hammer is one of the common tools used in workshop to facilitate various activities. Sketch the head of the given types of hammer and state one use for each.

(i) Straight pein hammer

Text Description: Rectangular head with flat striking face and narrow, straight pein on opposite side.

Use: Shaping metal or driving chisels.

(ii) Planishing hammer

Text Description: Rounded, polished head with slightly curved faces.

Use: Smoothing and finishing metal surfaces.

(iii) Blocking hammer

Text Description: Wide, flat head with short, sturdy handle.

Use: Forming sheet metal into curves.

(b) The figure below shows different types of tools and equipment used in bench workshop labeled with letters A to F. Identify the tools, material used to make them and two applications of each tool.

Without the figure, I'll assume common bench workshop tools:

Tool A: Scriber

Name: Scriber

Material made: High carbon steel

Application:

(i) Marking lines on metal.

(ii) Scribing arcs for cutting.

Tool B: Centre Punch

Name: Centre Punch

Material made: Hardened steel

Application:

(i) Marking drill points.

(ii) Indenting metal for alignment.

Tool C: Try Square

Name: Try Square

Material made: Steel and wood/plastic

Application:

(i) Checking right angles.

(ii) Marking perpendicular lines.

Tool D: Hacksaw

Name: Hacksaw

Material made: Steel frame, HSS blade

Application:

(i) Cutting metal bars.

(ii) Trimming pipes.

Tool E: File

Name: File

Material made: Hardened steel

Application:

(i) Smoothing metal surfaces.

(ii) Shaping edges.

Tool F: Vernier Caliper

Name: Vernier Caliper

Material made: Stainless steel

Application:

(i) Measuring internal/external dimensions.

(ii) Checking depth of holes.