THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

094 WELDING AND METAL FABRICATION

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2017**

Instructions

1. This paper consists of SIXTEEN questions.

2. Answer all questions in section A and B and three from section C.

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which one of the following is a fuel gas?
A Oxygen
B Carbon monoxide
C Oxide
D Acetylene
E Carbon dioxide
Answer: D
Reason: Acetylene is a common fuel gas used in oxy-acetylene welding due to its high flame temperature.

(ii) The function of a hose check valve is
A to mix fuel and oxygen gases to obtain the required melting flame
B to prevent the feedback of gases from regions of higher or lower pressures
C to guide the regulators when the cylinders are connected
D to prevent the damage of cylinders
E to guide the torch during cutting of metals
Answer: B
Reason: A check valve prevents backflow of gases which could cause dangerous reverse flow in the hose.

(iii) Rectifiers are transformers containing electrical device which changes
A reverse polarity to straight polarity
B AC to DC
C straight polarity to reverse polarity
D Three phase to single phase
E DC to AC
Answer: B
Reason: Rectifiers convert alternating current (AC) to direct current (DC), which is needed in some welding applications.

(iv) In leftward welding technique the welding torch is
A held in the left hand
B held at 90° to the horizontal
C moved ahead of the filler rod
D moved from left to the right
E held in the right hand
Answer: D
Reason: In leftward or forehand welding, the torch moves from left to right, ahead of the filler rod.

(v) When should a multiple bead be used on lap joint?
A When welding in corners
B When using thin plates

C When overhead welding
D When strong joints are required
E When clean joints are needed
Answer: D
Reason: Multiple beads are used to increase weld strength in lap joints, especially for structural integrity.

(vi) Galvanized iron is soft steel coated with
A molten brass
B molten aluminium
C molten zinc
D a plastic layer
E molten solder
Answer: C
Reason: Galvanizing involves coating steel with molten zinc to protect it from corrosion.

(vii) Which current is the most efficient during MIG welding?
A Direct Current Reverse Polarity (DCRP)
B Direct Current Straight Polarity (DCSP)
C Alternating Current (AC)
D Direct Current (DC)
E Low current
Answer: A
Reason: DCRP provides stable arc and deeper penetration in MIG welding, making it most efficient.

(viii) The edge preparation process in welding involves
A shaping the edges of the metal to accommodate the electrode diameter
B shaping of the edges to accommodate the weld metal and allow penetration
C straightening the edges by grinding
D heating the edges of the metal before welding
E filing the edges to dead smooth finishing to allow bonding with weld metal
Answer: B
Reason: Proper edge shaping allows proper weld penetration and fusion between the jointed parts.

(ix) The reason of preheating medium and high carbon steel before cutting with oxyacetylene flame is
A to refine the grain structure
B to improve the quality of the cut
C to eliminate carbon
D to prevent hardening and cracking
E to prevent bending
Answer: D
Reason: Preheating reduces thermal shock, thus preventing hardening and cracking in high carbon steels.

(x) Which of the following are non-destructive tests of a weld?

A X-ray and die penetrants
B Gamma ray and impact test
C Vicker's test and die penetrants
D Hardness and impact tests
E Ultrasound and hardness test
Answer: A
Reason: X-ray and dye penetrant testing allow internal and surface inspection of welds without damaging them.

2. Name three materials used to prevent the acetone escaping with gas in acetylene cylinders.

Porous mass: Materials like calcium silicate or asbestos are used to fill the cylinder and hold the acetone in place.
Acetone: It dissolves acetylene gas safely under pressure and reduces the risk of explosion.
Filler materials: Porous materials such as charcoal or balsa wood soaked in acetone help stabilize the acetylene gas.

3. Give two functions of an electrode holder.

It holds the electrode firmly during welding, allowing precise control and positioning of the arc.
It conducts electric current from the welding cable to the electrode, enabling arc generation for welding.

4. Define the following terms:
(i) Weld puddle
The weld puddle is the small pool of molten metal formed during the welding process, which solidifies to create the weld bead.

(ii) Weld pass
A weld pass refers to a single progression of welding along a joint, either in one direction or layer, forming part of a complete weld.

5. List three gases which are used in gas shielded arc welding.

Argon: An inert gas commonly used to shield the weld area from atmospheric contamination.
Carbon dioxide: Often used in MIG welding for deeper penetration.
Helium: Used in combination with argon for higher heat input and improved weld fluidity.

6. How is heat for resistance welding obtained?

Heat in resistance welding is generated by passing a high electric current through metal parts while applying pressure. The resistance to current flow at the contact surfaces produces heat, which melts the metal and creates the weld.

7. What type of oxyacetylene flame is suitable for each of the following operations?
(i) Bronze welding: Neutral flame – it has balanced oxygen and acetylene, suitable for non-ferrous metals.
(ii) Hard-facing of steel: Carburizing (reducing) flame – it adds carbon, useful in hard surfacing operations.
(iii) Steel welding: Neutral flame – prevents oxidation and ensures clean fusion of steel parts.

8. Distinguish a welding nozzle tip from a cutting torch tip.

A welding nozzle tip has a single opening, allowing controlled and focused flow of the flame for melting and joining metals.
A cutting torch tip has multiple holes, typically a central hole for oxygen and surrounding holes for fuel gas, enabling it to heat and also force a jet of oxygen to blow away molten metal during cutting.

9. Why a filler rod is employed in gas welding?

A filler rod is used to supply additional metal into the joint, helping to fill gaps and strengthen the weld. It ensures proper bonding between the workpieces and allows better control of the joint size and shape.

10. Name three tools or equipment which are used to clean corroded work surface before welding.

Wire brush: Removes rust, scale, and dirt from the metal surface.
Grinder: Smoothens and cleans the edges of thick metal before welding.
Chipping hammer: Used to knock off slag and corrosion deposits from the workpiece.
11. Outline three methods of heating a soldering iron.

Electric heating: This method uses an electrical resistance element within the soldering iron to produce heat when connected to a power source. It is the most common method in modern soldering tools due to its convenience and control.

Gas heating: A small flame powered by gas such as butane or propane is used to heat the soldering tip. This is typically used in portable or outdoor applications where electric power may not be available.

Charcoal or spirit lamp: In traditional or basic workshop settings, soldering irons are heated using an open flame such as from a charcoal fire or spirit lamp. The metal tip is placed in the flame until it reaches the desired temperature.

12.
(a) State two factors in which the adjustment of welding flame depends.
The type of metal being welded: Different metals require different flame characteristics (e.g., steel uses a neutral flame, while aluminum might need slightly oxidizing).
The type of welding process being performed: For example, cutting, brazing, or fusion welding may each require different flame settings.

(b) With the aid of diagrams, briefly explain three distinct oxy-acetylene flames settings and their uses.

Neutral flame: Produced by equal volumes of oxygen and acetylene. It has a clear, well-defined inner cone and is used for welding mild steel, stainless steel, and cast iron without altering the metal composition.

Carburizing (reducing) flame: Contains excess acetylene, resulting in a longer, feathered inner cone. It is used for welding high-carbon steels and non-ferrous metals, and for hard facing to avoid oxidation.

Oxidizing flame: Contains excess oxygen, producing a shorter, brighter inner cone. Used for welding brass and for cutting applications, though not suitable for steel due to potential oxidation.

13.
(a) With aid of diagram, mention the components which are comprised by manual metal arc welding equipment in a set up for welding. Exclude the work bench.
The components include:
Welding machine (AC or DC power source): Supplies current.
Electrode holder: Holds the electrode.
Ground clamp: Connects the workpiece to the welding circuit.
Electrode (coated): Melts to fill the joint.
Welding cables: Conduct electricity from the power source to the electrode and work clamp.
Face shield or helmet: Protects welder's eyes and face.
Chipping hammer and wire brush: For slag removal.

(b) With the aid of diagrams, briefly explain the two types of vertical welding positions.

Vertical-up (3G): Welding starts from the bottom and moves upward. This position offers good penetration and is suitable for thick materials.

Vertical-down (3G): Welding progresses from the top downward. It is faster and used on thin materials but may result in weaker joints.

14.
(a) Explain how brazing is carried out.
The two base metals are cleaned and positioned with a small gap. A filler metal with a lower melting point is placed at the joint. Heat is applied using a torch or furnace until the filler melts and flows by capillary action into the joint. On cooling, it solidifies to form a strong bond without melting the base metals.

(b) Give two advantages and two disadvantages of brazing.
Advantages:
It joins dissimilar metals.
Produces strong, leak-proof joints at relatively low temperatures.

Disadvantages:
Weaker than fusion welds.

Joint strength decreases at high temperatures.

15.
(a) Why is it important for a sheet metal worker to know the type of material of the required sheet metal for a particular job?
Different metals have varying properties like strength, malleability, corrosion resistance, and weldability. Knowing the metal type helps in selecting the correct tools, heat levels, and joining methods, which ensures safety, quality, and durability of the finished product.

(b) What is the function of each of the following machines in sheet metal works?

(i) Rolling machine: Reduces thickness or gives curvature to sheet metal by passing it through rollers.

(ii) Bending machine: Bends sheet metal to desired angles and shapes using dies or punches.

(iii) Shearing machine: Cuts sheets into sizes or shapes with a straight blade.

(iv) Folding machine: Folds sheet metal at precise angles, especially for creating hems or flanges.

(v) Double seaming machine: Used in making air-tight joints in containers, like tins, by folding and pressing edges together.

(vi) Grooving machine: Makes grooves or notches on metal surfaces, improving appearance or aiding in fitting.

(c) Give a brief explanation of properties and uses of the following sheet metal materials:

(i) Tin
Properties: Soft, malleable, corrosion-resistant.
Uses: Coating steel (tinplate), packaging (cans), and soldering applications.

(ii) Aluminium
Properties: Lightweight, corrosion-resistant, good conductor of electricity and heat.
Uses: Aircraft parts, roofing sheets, kitchen utensils, and transport equipment.

16.
(a) How does distortion occur to a heated metal in welding process?
Distortion occurs due to uneven heating and cooling. As metal expands when heated and contracts during cooling, differences in temperature across the weld zone cause pulling, warping, or buckling of the metal, leading to misalignment or deformation.

(b) Explain three main types of distortion that can be set up in welded structures, if care and preventive measures are not taken.

Longitudinal shrinkage: Occurs along the length of the weld, causing the material to contract and pull together, shortening the overall length.

Transverse shrinkage: Occurs across the weld seam, pulling the edges of the metal towards the center, leading to narrowing or bending.

Angular distortion: Happens when one side of the weld cools faster, resulting in rotation or tilting of the welded parts due to uneven contraction.

(c) Give any five ways to eliminate the effects of distortion during welding of metals.

Use of proper welding sequence: Balanced welding on both sides of the joint prevents stress accumulation.

Preheating: Reduces temperature gradients and thermal shock, ensuring even expansion and contraction.

Use of clamps and fixtures: Holds parts in position and resists deformation during welding.

Controlled heat input: Using appropriate welding speed, current, and electrode to minimize overheating.

Post-weld heat treatment: Allows slow cooling and stress relief, preventing residual stress and deformation.