THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

789 METAL WORKING AND MECHANICAL PRACTICE

Time: 3 Hour. **ANSWERS** **Year: 2010**

Instructions

1. This paper consists of **eight (8)** questions.
2. Answer any **five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Non-programmable calculators may be used.
5. Communication devices, programmable calculators and any unauthorized materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

1. (a) Rough filing is the initial stage of filing where a coarse file is used to remove large amounts of material quickly. It is different from smooth filing, which uses a finer file to produce a polished, accurate finish on the metal surface.

(b) (i) Types of files include flat files, which are used for general purpose work; round files, used to enlarge round holes; and triangular files, which are used for filing corners or angles.
(ii) Single-cut files have parallel rows of teeth and are used for finishing and smooth filing. Double-cut files have two intersecting rows of teeth, which allow faster material removal and are used during rough filing.

(c) Always use a handle on the file to prevent hand injuries. Do not use excessive pressure to avoid damaging the file teeth or the workpiece. Clean the file regularly with a file card to prevent clogging. File in one consistent direction and avoid back-and-forth movements to maintain accuracy.

(d) Files are simple and affordable tools that do not require power. They can reach areas that machines cannot. However, they require physical effort and are time-consuming. Also, they may not produce uniform results across multiple parts.

2. (a) A limit gauge is a device used to determine whether a part's dimension falls within a specified tolerance range. It does not measure the dimension but simply checks if the part is acceptable or not.

(b) (i) A “go” gauge checks if the part meets the minimum dimensional requirement and should pass through or fit easily. A “no-go” gauge checks if the part exceeds the maximum allowable size and should not fit.
(ii) Limit gauges allow for quick checking of parts, especially in mass production. They reduce the possibility of human error. They also eliminate the need for detailed measurements in simple go/no-go situations.

(c) A plug gauge is inserted into the drilled hole. If the “go” side enters and the “no-go” side does not, the hole is within tolerance. If either fails, the hole must be rechecked or rejected.

(d) Gauges must be calibrated to maintain accuracy and reliability. Frequent use can cause wear and tear, affecting results. Dirty or damaged gauges may give false readings. Regular calibration ensures consistent inspection standards.

3. (a) Drill runout is the deviation of the drill bit from its intended circular path during rotation. It results in holes that are not perfectly round or centered.

(b) (i) Drill runout can be caused by a bent drill bit, misalignment in the drill chuck, or worn spindle bearings.
(ii) Runout affects hole roundness, causing it to be oversized or uneven. It also reduces the life of the drill bit due to uneven cutting forces.

(c) To check runout, rotate the drill manually and use a dial indicator to measure any wobble. Correction involves replacing bent drills, tightening the chuck properly, or realigning the spindle or arbor.

(d) Ensure the workpiece is clamped firmly. Use a centre punch to mark the drilling point. Start with a pilot hole for large diameters. Use sharp and properly aligned drill bits.

4. (a) A power hacksaw is a machine tool that uses a reciprocating blade to cut metal bars and rods. It is commonly used in workshops to produce straight cuts on medium to large metal stock.

(b) (i) A power hacksaw operates automatically while a hand hacksaw requires manual operation. The power hacksaw cuts faster and is suitable for repetitive work. It also maintains consistent pressure and feed rate, unlike manual sawing.
(ii) Maintenance includes keeping the machine well lubricated and ensuring the blade is tightened properly. The cutting area must be cleaned regularly to remove chips and ensure free blade movement.

(c) Always wear eye protection when operating the machine. Do not touch the blade while it's moving. Clamp the workpiece securely before starting. Keep hands away from the cutting zone and avoid distractions.

(d) The blade tensioning mechanism holds the blade firmly in the frame. It ensures proper pressure during cutting, prevents blade vibration, and reduces the risk of breakage or crooked cuts.

5. (a) A dead centre is a pointed metal piece fixed in the tailstock of a lathe. It supports the free end of a long workpiece and does not rotate with the work.

(b) (i) A live centre rotates with the workpiece and is mounted on ball bearings. A dead centre remains stationary while the work rotates around it.

(ii) A live centre reduces friction and is used for high-speed turning. A dead centre requires frequent lubrication to avoid wear from friction.

(c) To mount a workpiece between centres, fit the workpiece between the headstock centre and the tailstock dead centre. Tighten the tailstock spindle to apply pressure. Rotate the work by hand to ensure it is freely turning before starting the machine.

(d) Turning between centres ensures concentricity of the workpiece. It allows easy removal and remounting without losing alignment. It reduces deflection in long shafts. It supports better finish and dimensional control.

6. (a) An undercut in welding is a groove formed at the weld toe due to excessive melting of the base metal without proper filling. It weakens the weld and can lead to crack initiation.

(b) (i) Causes of undercut include using excessive welding current, fast travel speed, and improper electrode angle.
(ii) To prevent undercut, use the correct current settings and maintain a consistent travel speed. Adjust the electrode angle to ensure proper metal deposition at the weld edge.

(c) A good weld has a uniform bead, no visible cracks, and consistent penetration. It should not have porosity or slag inclusions, and the edges should blend smoothly into the base metal.

(d) Other welding defects include porosity, which consists of trapped gas bubbles. Slag inclusion, where non-metallic material gets embedded in the weld. Cracks, both surface and internal. Incomplete fusion, where the weld metal fails to bond with the base.

7. (a) A riveting set is a hand tool used to shape the end of a rivet into a head after it has been inserted through the workpieces. It ensures a tight and clean finish to the joint.

(b) (i) Common rivet head types include snap head, pan head, and countersunk head.
(ii) To form a rivet head, support the rivet's tail on a bucking bar or solid surface. Use the riveting set and hammer to gradually shape the protruding end into a dome or flush head, depending on the rivet type.

(c) Inspection involves checking that both rivet heads are properly formed with no cracks. The joint should be tight, with no gaps between sheets. Rivets should not rotate or feel loose under pressure.

(d) Riveting allows joining without heat, avoiding distortion. It is simple and requires minimal tools. However, it can only join overlapping materials. It is also not suitable for thick or complex assemblies requiring internal access.

8. (a) Bending allowance is the amount of material required to compensate for stretching during bending. It ensures that the final bent component has accurate overall dimensions.

(b) (i) Factors affecting bending allowance include the thickness of the sheet metal, the bend radius, and the material type.
(ii) Tools commonly used include bending brakes for sheet folding and hand seamers for small bends and adjustments.

(c) To make a 90-degree bend, first measure and mark the bend line. Clamp the metal securely in a bending brake with the line aligned at the brake's edge. Pull or press the metal to form the 90-degree bend gradually, checking angle alignment.

(d) Cracks can be caused by bending metal that is too cold or brittle. Using a small bend radius on thick or hard materials also leads to cracking. To avoid this, preheat the material if necessary and use the recommended radius for the material thickness.