THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

095 FITTING AND TURNING

(For Both School and Private Candidates)

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

Instructions

1. This paper consists of SIXTEN questions.

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

(i) Which of the following is used to hold firmly the workpiece for drilling?
A. Bench vice
B. Machine vice
C. G-clamp
D. Vee plate
E. Angle plate

Correct answer: B. Machine vice
Reason: A machine vice is specifically designed to securely hold workpieces on a drilling machine, ensuring stability and precision.

(ii) What is the tolerance from the dimension expressed as $40^{+0.025}_{-0.055}$?
A. 0.09 mm
B. 0.035 mm
C. 0.009 mm
D. 0.020 mm
E. 0.055 mm

Correct answer: A. 0.09 mm
Reason: Tolerance is the total range of variation, calculated as 0.025 + 0.055 = 0.080 mm.

(iii) In which of the following machines is the cutting tool in Figure 1 fixed?
A. Shaper machine
B. Milling machine
C. Grinding machine
D. Lathe machine
E. Drilling machine

Correct answer: D. Lathe machine
Reason: In a lathe machine, the workpiece rotates while the cutting tool remains stationary or fixed.

(iv) In a unilateral system of tolerance, the tolerance is allowed on
A. One side of the actual size
B. Both sides of the actual size
C. One side of the nominal size
D. Either sides of the actual size
E. Either sides of the nominal size

Correct answer: C. One side of the nominal size
Reason: In unilateral tolerance, variation is permitted only in one direction from the nominal size, typically either above or below.

(v) Which of the following cutting tools is used to separate workpiece into two parts on lathe machine?

A. Knurling tool
B. Parallel turning tool
C. Parting off tool
D. Round nose tool
E. Taper turning tool

Correct answer: C. Parting off tool
Reason: A parting off tool is specifically used to cut off or separate part of the workpiece on a lathe.

(vi) Catch plate is an accessory used in lathe machine when
A. Turning without tailstock support
B. Turning between centres
C. Setting the tool at centre axis
D. Turning at high speed
E. Turning with a compound rest

Correct answer: B. Turning between centres
Reason: Catch plates are used in lathe operations to drive the workpiece when it is held between centres.

(vii) The algebraic difference between the maximum limit and basic size is called
A. Actual deviation
B. Lower deviation
C. Tolerance
D. Upper deviation
E. Fundamental deviation

Correct answer: C. Tolerance
Reason: Tolerance is the total permissible variation in size between the upper and lower limits.

(viii) The screw extractor is a tool used to remove
A. A broken tap
B. A first tap
C. A clogged tap
D. A starting tap
E. A clearing tap

Correct answer: A. A broken tap
Reason: Screw extractors are designed to remove broken taps or bolts from workpieces.

(ix) Which of the following operations is carried out on the apparatus in Figure 2?
A. Forging
B. Up cutting
C. Threading

D. Knurling
E. Down cutting

Correct answer: A. Forging
Reason: The apparatus shown is an anvil, commonly used in forging operations to shape metal.

(x) What is the purpose of knurled portion of the workpiece?
A. To produce stepped diameter on a workpiece
B. To produce a thread on a workpiece
C. To reduce the diameter of a workpiece
D. To make a neck on a workpiece
E. To facilitate strong gripping on a workpiece

Correct answer: E. To facilitate strong gripping on a workpiece
Reason: Knurling creates a textured pattern that provides a better grip on cylindrical surfaces.

2. Mention three uses of surface gauges in the workshop.
Surface gauges are used for the following purposes:

They are used to scribe parallel lines on the surface of a workpiece. This helps in marking lines that are consistent and parallel to the base surface.

They are used to test the flatness or straightness of surfaces by moving the gauge across the surface while observing the contact.

They are used for aligning and setting up workpieces on machine tools by providing a reference height or level for adjustment.

3. Enumerate six tools used in sheet metal work.
Mallets – used to shape and form sheet metal without damaging the surface.
Stakes – used as support tools for shaping sheet metal by providing form or contour.
Tinman's anvil – used for forming and straightening metal sheets.
Hand groover – used to create grooves or bends along sheet metal.
Half moon – used for creating curves or arcs in the sheet.
Creasing iron – used to create sharp creases or bends in sheet metal.

4. (a) What is lathe dog with regard to lathe machine?
A lathe dog is a device used to transmit motion from the driving plate or faceplate to the workpiece when it is held between centers. It is clamped onto the workpiece, and its tail fits into a slot on the faceplate, enabling rotation.

(b) What is the use of a tool in Figure 3?

The tool shown in Figure 3 is a die, and it is used for cutting external threads on cylindrical workpieces such as bolts or rods.

5. Give three types of natural abrasives.
Diamond – the hardest natural abrasive used for cutting and grinding hard materials.
Emery – a natural abrasive composed mainly of aluminum oxide, used for polishing and fine grinding.
Corundum – a crystalline form of aluminum oxide used in sandpapers and grinding wheels.

6. List three types of twist drills.
Taper shank twist drill – has a tapered end that fits directly into the machine spindle.
Parallel shank twist drill – has a straight shank and is held by a drill chuck.
Subland drill – a specialized twist drill designed to drill holes of different diameters in one pass.

7. Define the following machine parts with regard to shaper machine:
(a) Ram:
The ram is the reciprocating component of the shaper machine that holds the cutting tool and moves it back and forth across the workpiece in a straight line.

(b) Shaper head:
The shaper head is the part of the machine attached to the ram that holds and adjusts the position and angle of the cutting tool.

8. Give three examples of the two methods of joining metals in engineering.
Permanent methods:
Riveting – joining metal parts using rivets.
Welding – fusing metal parts by applying heat or pressure.
Brazing – joining metals using a filler metal at a temperature below their melting point.

Temporary methods:
Bolting – joining using bolts and nuts.
Screwing – using screws to join or fasten parts.
Clamping – using clamps to hold parts together temporarily.

9. (a) What is the name of the apparatus shown in Figure 4?
The apparatus shown in Figure 4 is called a bench vice. A bench vice is a mechanical device used to hold a workpiece securely in place while work such as sawing, drilling, filing, or shaping is performed. It is usually mounted on a workbench and has two parallel jaws—one fixed and one movable—used to grip the object.

(b) Name the parts of the apparatus indicated by letters a and b.
a – Handle: This is the long metal rod located at the base of the vice. It is used to rotate the lead screw, which opens and closes the movable jaw. By turning the handle clockwise or counterclockwise, the user can adjust the grip of the vice.

b – Jaw: This refers to the flat gripping surfaces that clamp the workpiece. One jaw is fixed, and the other is movable. The inner faces of the jaws often have textured or serrated surfaces to grip the workpiece more effectively and prevent slipping.

10. Give the uses of the following types of files:
(a) Single cut file:
A single cut file has rows of teeth that are cut in one direction only. It is primarily used for rough or heavy stock removal, especially on soft materials like brass, aluminum, and soft steel. The file produces a smoother finish compared to double cut files and is used for fine, precision filing. It is ideal for sharpening tools, smoothing edges, and performing finishing operations.

(b) Double cut file:
A double cut file has two sets of teeth—one set angled to the right and another to the left—creating a diamond pattern. This type of file is used for rapid removal of material and is more aggressive than a single cut file. It is especially suitable for filing hard materials such as steel and iron. Double cut files are commonly used for rough work, such as deburring, shaping, and leveling uneven surfaces.

11. State three safety precautions to be observed before starting to drill a hole.
First, ensure the workpiece is securely clamped using a vice or clamp to prevent it from spinning or moving during drilling. Loose workpieces can cause accidents or damage the drill bit.

Second, wear appropriate personal protective equipment such as safety goggles to protect your eyes from flying chips or metal shavings, and gloves to protect your hands from sharp edges and hot surfaces.

Third, inspect the drill bit and machine before use to ensure there are no defects. A dull or cracked drill bit can break during operation, causing injury or producing poor quality holes. Also, ensure the drill is running at the correct speed for the material and drill size.
12. (a) What are the four important general safety practices to be considered when working with rotating machines?
First, always wear proper personal protective equipment such as goggles and gloves to protect against flying chips and hot surfaces.
Second, ensure that all rotating parts are covered with guards to prevent accidental contact with moving parts.
Third, avoid wearing loose clothing or accessories like ties and jewelry that can get caught in rotating components.
Fourth, always inspect the machine and tools for damage or wear before use to prevent malfunctions or accidents during operation.

(b) (i) Define micrometer screw gauge.
A micrometer screw gauge is a precision measuring instrument used to measure very small dimensions with high accuracy, typically to the nearest 0.01 mm or 0.001 inch. It is commonly used in mechanical and metalworking tasks.

(ii) Briefly explain how is the micrometer screw gauge used.
To use the micrometer, the object to be measured is placed between the anvil and the spindle. The thimble is rotated until the spindle touches the object gently. The reading is taken from the sleeve and thimble scale. For accuracy, a ratchet mechanism is used to apply consistent pressure while taking the measurement.

13. (a) (i) Define lathe machine.
A lathe machine is a machine tool that rotates a workpiece about an axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation using cutting tools that are applied to the workpiece to create symmetrical objects.

(ii) Describe four main parts of a lathe machine.
Bed: The base of the lathe that supports all other components and ensures alignment.
Headstock: Located on the left side of the bed, it contains the motor, spindle, and speed control mechanism.
Tailstock: Positioned on the right side of the bed, it supports the free end of the workpiece and can hold tools such as drills.
Carriage: It holds and moves the cutting tool and consists of components like the saddle, cross-slide, and tool post.

(b) Describe four major parts of the carriage of a lathe machine.
Saddle: Sits on the lathe bed and supports the cross-slide.
Cross-slide: Mounted on the saddle and moves perpendicular to the spindle axis to adjust cutting depth.
Compound rest: Mounted on the cross-slide, allows angular adjustment of the tool.
Tool post: Holds the cutting tool firmly in position during operation.

14. (a) Describe the problems that can be associated with drilling holes in sheet metal and state how to overcome the problems.
Problem 1: Sheet metal may deform or bend while drilling due to its thin nature.
Solution: Place a wooden or solid metal backing under the sheet to support it.

Problem 2: Drill bits may wander or slip off the surface.
Solution: Use a center punch to create an indentation to guide the drill bit.

Problem 3: Burrs may form around the hole edges.
Solution: Use a sharp drill bit and apply moderate feed; deburr the edges after drilling.

Problem 4: The hole may not be clean or to the correct size.
Solution: Use appropriate drill speed, correct drill size, and ensure the drill bit is sharp.

(b) Briefly describe the following parts of a twist drill:
(i) The web:

The web is the central portion of the drill body that connects the two cutting edges. It provides strength to the drill bit and supports the point during cutting.

(ii) The point:
The point is the sharpened tip of the drill that initiates cutting. It includes the chisel edge and lips that create the hole by removing material as the drill rotates.

15. (a) Distinguish between the following with regard to lathe machine:
(i) Material removal rate and depth of cut:
Material removal rate refers to the volume of material removed per unit time, while depth of cut refers to the thickness of material removed in one pass of the tool.

(ii) Cutting speed and feed rate:
Cutting speed is the speed at which the cutting edge moves relative to the workpiece surface, typically in meters per minute. Feed rate is the distance the tool advances along the workpiece for each revolution, usually in mm/rev.

(iii) Catch or driving plate and faceplate:
Catch plate or driving plate is used to transmit motion from the spindle to the workpiece when turning between centers. A faceplate is a large disc with slots used to mount irregularly shaped workpieces.

(iv) Three jaw chuck and four jaw chuck:
A three jaw chuck is self-centering and used for holding round or hexagonal workpieces. A four jaw chuck is independent and allows each jaw to be adjusted separately, suitable for irregular shapes.

16. (a) Calculate the time required for drilling the hole when a workpiece of a thickness of 100 mm is drilled by using a twist drill of diameter of 70 mm. Assume the cutting speed of 44 m/min and feed rate of 0.4 mm/rev are used. Neglect the length of approach.
First, calculate spindle speed:
$N = (1000 \times V) / (\pi \times D)$
$N = (1000 \times 44) / (3.14 \times 70)$
$N = 44000 / 219.8 = 200.2$ rev/min

Now calculate the time:
Time = Length of hole / (Feed per rev × N)
Time = 100 / (0.4 × 200.2)
Time = 100 / 80.08 = 1.25 minutes

(b) Briefly explain the following fits with regard to Limits and Fits:
(i) Fit:
Fit refers to the degree of tightness or looseness between two mating parts such as a hole and a shaft.

(ii) Push fit:

Push fit allows slight pressure insertion of parts with very little clearance. It is used when a snug but not tight fit is required.

(iii) Press fit:
Press fit involves forceful insertion of a part into another, usually resulting in a permanent joint with no clearance.

(iv) Running fit:
Running fit provides enough clearance for free movement between parts, commonly used in rotating shafts and bearings.