**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: 2016**

**Instructions**

1. This paper consists of SIXTEN questions.

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

1. (i) The accuracy of micrometers, calipers and dial indicators can be checked by
A. Feller gauge
B. Snap gauge
C. Ring gauge
D. Plug gauge
E. Slip gauge

Correct answer: E. Slip gauge
Reason: Slip gauges are precision ground blocks used to calibrate and check the accuracy of measuring instruments.

(ii) In a bilateral system of tolerance, the tolerance is allowed on
A. One side of the actual size
B. One side of the nominal size
C. Both sides of the actual size
D. Both sides of the nominal size
E. Not of either sides of actual or nominal size

Correct answer: D. Both sides of the nominal size
Reason: In bilateral tolerance, variations are allowed on both sides of the nominal dimension.

(iii) Which of the following chisel is used for cutting key ways?
A. Round nose chisel
B. Half round nose chisel
C. Diamond pointed chisel
D. Flat chisel
E. Cape chisel

Correct answer: E. Cape chisel
Reason: Cape chisels are narrow and are used for cutting slots and keyways.

(iv) What are the uses of fullers tool in fitting and turning workshops?
A. Finishing flat surfaces
B. Punching a hole
C. Finishing punched holes
D. Necking down a piece of work
E. Making round shapes

Correct answer: D. Necking down a piece of work
Reason: Fullers are used to reduce or narrow down parts of the workpiece.

(v) In a four high rolling mill, there are four rolls out of which
A. One is working roll and three are backing up roll

B. All of the four are working rolls
C. Two are working rolls and two are backing up rolls
D. Three are working rolls and one is backing up roll
E. All of the four are backing up rolls

Correct answer: C. Two are working rolls and two are backing up rolls
Reason: In a four-high rolling mill, the two inner rolls are working rolls and the two outer rolls are backing rolls.

(vi) To prevent the body of the blade from jamming in the saw cut, the teeth of blade are
A. Set
B. Sharpened
C. Strengthened
D. Hardened
E. Treated

Correct answer: A. Set
Reason: Setting the teeth ensures they alternate in direction, creating a wider cut than the blade and preventing jamming.

(vii) When the dimension is expressed as $20^{+0.015}_{-0.025}$, then the tolerance is
A. 0.60 mm
B. 0.06 mm
C. 0.01 mm
D. 0.006 mm
E. 0.025 mm

Correct answer: A. 0.06 mm
Reason: Tolerance is calculated as the sum of upper and lower deviations: 0.015 + 0.045 = 0.06 mm.

(viii) The grinding machine which can grind to close tolerance finish, harder and non-harder work is known as
A. Centreless grinder
B. Cylindrical grinder
C. Surface grinder
D. Pedal grinder
E. Portable angle grinder

Correct answer: A. Centreless grinder
Reason: Centreless grinders provide precise tolerance finishes without holding the workpiece between centers.

(ix) Parallel Turning is the operation which is performed on

A. Drilling machine
B. Grinding machine
C. Milling machine
D. Shaper machine
E. Lathe machine

Correct answer: E. Lathe machine
Reason: Parallel turning is performed on a lathe to produce cylindrical parts of uniform diameter.

(x) The part of twist drill that serves as a way of coolant penetration is known as
A. Flutes
B. Land
C. Tips
D. Shank
E. Lips
Correct answer: A. Flutes
Reason: Flutes are grooves that allow coolant to reach the cutting edge and chips to exit during drilling.
2. Define the following with regard to lathe machine:
(a) Feed rate:
Feed rate is the distance that the cutting tool advances along the surface of the workpiece during one complete revolution of the workpiece. It is usually measured in millimeters per revolution (mm/rev). A proper feed rate ensures efficient material removal without damaging the tool or workpiece.

(b) Setup of machine:
Setup of machine refers to the entire process of preparing the lathe for machining. It includes mounting the workpiece securely, selecting and installing the correct cutting tool, adjusting speeds and feeds, aligning the tool with the workpiece, and ensuring all safety measures are in place before starting the operation.

3. Describe the tool in Figure 1 as used in Fitting and Turning workshop.
The tool shown in Figure 1 is a steel rule. It is a basic linear measuring tool used in workshops for checking or marking straight-line dimensions. It is made of steel and marked with calibrated divisions in millimeters or inches. Steel rules are used to measure or scribe lines for layout purposes in both fitting and turning operations.

4. Name three factors which affect the surface finishing of the machined workpiece.
Cutting speed: High or low cutting speed affects the smoothness of the surface depending on the material and tool used.
Feed rate: A high feed rate may result in a rougher surface, while a low feed rate produces a smoother finish.
Condition of cutting tool: A sharp and properly shaped cutting tool will give a better surface finish compared to a dull or worn-out tool.

5. Differentiate the carriage from apron with regard to lathe machine parts.

The carriage is the main assembly on a lathe that supports and moves the cutting tool. It consists of the saddle, cross-slide, compound rest, and tool post. The apron is a part of the carriage, mounted at its front, containing the gears and levers for controlling the movement of the carriage through leadscrew and feed rod.

6. Sketch a scriber and explain its function in fitting and turning workshop.
A scriber is a sharp-pointed hand tool made of hardened steel used to mark or scribe lines on metal surfaces. It is used in layout work to guide cutting or machining. Its fine point allows accurate marking that doesn't rub off like chalk or pencil.

7. Distinguish the following materials as used on the grinding wheel:
(a) Abrasive:
Abrasive is the hard, sharp material bonded together in the grinding wheel used to cut or grind away the material from the workpiece. Common abrasives include aluminum oxide and silicon carbide.

(b) Bond:
Bond is the material that holds the abrasive grains together in the grinding wheel. It determines the strength and wear rate of the wheel. Common types include vitrified, resin, rubber, and metal bonds.

8. State the functions of the following accessories:
(a) Mandrel:
A mandrel is a cylindrical shaft used to hold hollow workpieces during machining. It supports the workpiece between centers and ensures concentric rotation during turning operations.

(b) Face plate:
A face plate is a large flat disc with slots used for mounting irregularly shaped or large workpieces on a lathe. It is attached to the spindle and allows clamping of workpieces that cannot be held with a chuck.

9. Differentiate between continuous chips and discontinuous chips.
Continuous chips are long, unbroken strips of metal formed during cutting soft, ductile materials at high speeds and using sharp tools. They usually result in a better surface finish.
Discontinuous chips are small, segmented pieces formed when cutting brittle materials or under poor machining conditions. They are common in interrupted cutting and may lead to poor surface quality.

10. Name three common holding devices used in drilling machine.
Vice: A mechanical device used to clamp the workpiece firmly during drilling.
Vee block: Used to hold cylindrical workpieces in position while drilling.
Drill clamp: A device used to hold irregular-shaped workpieces that cannot be secured by a vice.

11. Identify the tool in Figure 2 and state its function.
The tool in Figure 2 is a flat file. It is used for smoothing and shaping metal surfaces in fitting and turning workshops. It has cutting teeth and is operated by hand to remove small amounts of material to achieve desired shape and finish.

12. (a) A workpiece of a thickness of 50 mm is to be drilled a hole having a diameter of 35 mm. Calculate the time required for drilling the hole, assume the cutting speed of 22 m/min and feed rate of 0.2 mm/rev are used. Neglect the length of approach.

First, find the spindle speed:
$N = (1000 \times V) / (\pi \times D)$
$N = (1000 \times 22) / (3.14 \times 35)$
$N = 22000 / 109.9 = 200.2$ rev/min

Now calculate the time:
$Time = L / (f \times N)$
$Time = 50 / (0.2 \times 200.2)$
$Time = 50 / 40.04 = 1.25$ minutes

(b) Outline five advantages which make an operator to opt using hydraulic drive in shaping machines.
Hydraulic drive provides constant and smooth cutting motion, reducing vibrations.
It allows for stepless control of cutting speeds and return speeds.
Offers overload protection which increases operator safety and machine durability.
Requires less maintenance as it has fewer moving mechanical parts.
Enables automation and consistent performance across multiple workpieces.

13. (a) (i) Name the parts of the micrometer screw gauge in Figure 3.
a – Frame
b – Anvil
c – Spindle
d – Thimble
e – Ratchet
f – Sleeve or barrel
g – Lock

(ii) Explain four procedures to follow when measuring the size of diameter using the micrometer.
Ensure the micrometer is clean and zeroed properly before use.
Place the object gently between the anvil and spindle.
Rotate the thimble until the spindle contacts the object with light pressure.
Use the ratchet to avoid excessive force and take the reading from the sleeve and thimble.

(b) Briefly describe the following types of calipers with respect to their shape and application:
(i) Hermaphrodite calipers: Used to mark lines parallel to an edge by combining a caliper leg and a scribing point.
(ii) Spring-loaded calipers: Used to measure or transfer internal or external dimensions with a spring mechanism for tension.
(iii) Inside caliper: Measures the internal dimensions of an object such as a hole or slot.
(iv) Outside caliper: Measures the external dimensions like the outside of shafts or thicknesses.

14. (a) (i) Give the name of filing methods shown in Figure 4 (i) and (ii).
(i) Cross filing
(ii) Draw filing

(ii) Briefly explain the methods of filing in Figure 4 (i) and (ii).
Cross filing involves pushing the file diagonally across the workpiece surface, removing more material and creating a flat surface.
Draw filing involves holding the file at both ends and pulling it across the surface in a straight line to produce a smooth, fine finish.

(b) Briefly describe 'pinning' as encountered in filing process, stating its effect and how it can be prevented and removed from a file.
Pinning occurs when small metal particles get embedded between the teeth of a file. It affects surface finish and reduces efficiency.
It can be prevented by using chalk on the file before use. It can be removed using a file card or wire brush to clean the file.

15. (a) Describe the flat and square files according to their shapes and uses.
Flat file is rectangular in cross-section and tapered slightly at the end. It is used for general purpose filing of flat surfaces and edges.
Square file is square in cross-section and used for filing square corners, slots, and keyways.

(b) Give the meaning of the standard marking system given on grinding wheel as A 36 - V - G.
A – Abrasive type (A = Aluminum oxide)
36 – Grit size (36 = medium grit)
V – Bond type (V = vitrified bond)
G – Grade or hardness of the bond (G = medium)

(c) Write down six benefits of applying coolant during grinding operations.
Reduces heat and prevents workpiece burning.
Improves surface finish.
Extends the life of grinding wheel.
Flushes away chips and debris.
Reduces wear of the tool.
Allows higher cutting speeds.

(d) What are the uses of the following wheel shapes:
(i) Straight wheels – Used for cylindrical, surface, and centerless grinding.
(ii) Tapered face wheels – Used for grinding threads and gear teeth.
(iii) Ring or cylindrical wheels – Used for cylindrical grinding of shafts.
(iv) Flaring cup wheel – Used for tool and cutter grinding.
(v) Form grinding wheels – Used for grinding complex profiles and shapes.

(vi) Mounted points wheels – Used for internal grinding or intricate work.
(vii) Cup wheels – Used for tool sharpening and surface grinding.

16. (a) Describe three methods used for indexing in a milling machine.
Direct indexing: Uses a plate with holes and a pin to rotate the workpiece by fixed angles.
Simple indexing: Involves a crank and indexing plate with a worm and gear mechanism to rotate the workpiece.
Compound indexing: Uses a combination of indexing plates and gears to achieve divisions that simple indexing cannot.

(b) Describe how spiral milling is performed in a milling machine.
Spiral milling involves rotating the workpiece slowly while the cutter moves linearly, producing a spiral groove. It is achieved by connecting the machine's table feed with the rotation of the dividing head using gears, allowing synchronized movement for accurate spiral generation.