THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

090 **MECHANICAL ENGINEERING**

Time: 2:30 Hours. **ANSWER** **Year: 2024**

Instructions

1. This paper consists of sections **A**, **B** and **C** with a total of **ten (10)** questions.
2. Answer **all** questions.
3. Section A carries **15** marks; section B carries **70** marks and section C carries **15** marks.
4. All writing must be in **black** or **blue** ink and drawings must be in **pencil**.
5. Cellular phones and unauthorized materials are **not allowed** in the examination room.
6. Write your **Assessment Number** at the top-right hand corner of every page.

FOR EXAMINER'S USE ONLY		
QUESTION NUMBER	SCORE	EXAMINER'S INITIALS
1		
2		
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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) During the mechanical engineering practical session the teacher provided the grinding disc labelled WA36K5R17. What does the alphabet A K and R indicated in the disc represent.

A Abrasive Grade

B Abrasive Structure and Prefix

C Abrasive Grade and Bond

D Abrasive Grain and Bond

Correct answer: D. Abrasive Grain and Bond

Reason: In a grinding wheel code, the letter A represents the abrasive grain type (Aluminium oxide), K represents the grade or hardness, and R represents the bond type that holds the abrasive particles together.

(ii) The Form Two students were doing practical in a workshop. Suddenly an accident occurred whereby one of the students fell in the grinding machine. In such incidence who is the responsible person to be notified about an accident.

A The immediate supervisor

B The subject teacher

C The medical doctor

D Class representative

Correct answer: A. The immediate supervisor

Reason: The immediate supervisor must be informed first since they are responsible for safety, can take quick action, and ensure that the incident is properly reported and handled.

(iii) Rightward and leftward are two techniques which can be used in joining metal process by using gas welding. Why are rightward techniques merely applied than leftward techniques.

A The process is suitable for welding thin plates

B The process is suitable for welding both thin plates and thick plates

C The process is suitable for welding thick plates

D The process is suitable for joining dissimilar metals

Correct answer: C. The process is suitable for welding thick plates

Reason: The rightward technique is preferred because it provides better heat concentration and deeper penetration, which is ideal for joining thicker metal plates effectively.

(iv) Why is cast iron unfit for construction of a bridge compared to steel.

A It is brittle due to presence of austenite element

B It is brittle due to presence of ferrite element

C It is brittle due to lack of ferric material

D It is brittle due to presence of carbon element

Correct answer: D. It is brittle due to presence of carbon element

Reason: Cast iron contains a high amount of carbon which makes it brittle and unable to withstand bending or tensile stress, unlike steel which is tough and flexible.

(v) Which of the following is a proper setting used to prevent jamming or binding of hacksaw blade teeth.

A Kerf set

B Swarf set

C Rasp set

D Wavy set

Correct answer: A. Kerf set

Reason: In a kerf set, the teeth of the hacksaw are alternately bent outward to create a cut slightly wider than the blade thickness, preventing the blade from binding during cutting.

(vi) The contractor needs porous materials to retain the amount of heat on construction of iron smelting furnace. Which one is an appropriate material needed for the construction.

A Steel casing

B Fire bricks

C Clay

D Asbestos

Correct answer: B. Fire bricks

Reason: Fire bricks are refractory materials capable of withstanding high temperatures and retaining heat, making them suitable for furnace construction.

(vii) Form Two students were required to draw circles which are beyond the capacity of a compass. Which alternative instrument may be used.

A Callipers

B Divider

C Trammels

D Height Gauge

Correct answer: C. Trammels

Reason: Trammels are used for drawing large circles or arcs beyond the range of an ordinary compass by adjusting the spacing between the points.

(viii) The following are the factors which attribute to the outbreak of electrical fire except.

A Poor quality of electrical installation of wiring

B Application of electric rodent repellents in the cable

C Poor maintenance of some of the fire hydrant

D Unsystematic dumping of wooden packing material

Correct answer: B. Application of electric rodent repellents in the cable

Reason: Electrical fires usually result from poor wiring, maintenance, or unsafe storage of materials, not from rodent repellents which are actually preventive measures.

(ix) Which one of the following is a direct factor having impact on the risks associated with executer in the workshop.

A Make sure the floor is uneven

B Have the floor cleaned extra often

C Make sure the workplace is tidy

D Have the floor safety signed and marked

Correct answer: C. Make sure the workplace is tidy

Reason: A tidy workplace minimizes the chances of accidents such as slips, trips, and falls, thereby ensuring a safe working environment.

(x) Which of the following is used for dressing and trueing an abrasive grinding wheel on a tool and utility grinder.

A Diamond tool dresser

B Abrasive stick wheel dresser

C Huntington wheel dresser

D Truing wheel dresser

Correct answer: C. Huntington wheel dresser

Reason: The Huntington wheel dresser is specifically designed to true and clean grinding wheels, restoring their cutting surface and maintaining balance for smooth operation.

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	List B
(i) The ability of metal to withstand deformation under compression without rapture (ii) Measure the amount of energy the material can absorb before failure taken place (iii) The ability of material to resist deformation (iv) The ability of material to withstand elongation under tension without rapture (v) The ability of material to sustain load without distortion.	A Toughness B Hardness C Malleability D Stiffness E Brittleness F Ductility G Resistance H Strength

i	ii	iii	iv	v
C	**A**	**D**	**F**	**H**

3. (a) Students are encouraged to observe personal, equipment, and environmental safety during learning in the workshop for several reasons.
   Firstly, it helps prevent injuries and accidents that can occur due to carelessness or improper handling of tools and machines. By wearing proper protective gear and following safety guidelines, students minimize the risk of physical harm.

   Secondly, observing safety ensures that workshop equipment and tools remain in good working condition. When students use machines correctly and perform regular maintenance, the lifespan of the equipment is prolonged, reducing repair costs and downtime.

   Thirdly, maintaining environmental safety in the workshop prevents hazards such as fires, spills, and pollution. Clean and organized work areas reduce the risk of slips, chemical exposure, and contamination, which contributes to a healthier learning environment.

   (b) Safety rules should be observed in industries for the following reasons.

   Firstly, they protect workers from physical harm and occupational diseases that may result from exposure to dangerous equipment, chemicals, or poor working conditions.

   Secondly, adherence to safety rules reduces production downtime caused by accidents, ensuring smooth and continuous industrial operations.

   Thirdly, observing safety rules enhances productivity, as workers feel secure and confident in their work environment, leading to better performance and fewer disruptions.

   Fourthly, safety compliance helps companies avoid legal penalties and compensation claims arising from workplace injuries. It ensures conformity with national and international occupational safety standards.

   Fifthly, safety rules protect company property and equipment from damage due to improper use or negligence.
   Sixthly, maintaining industrial safety helps create a positive company image, showing that the organization values the welfare of its workers.

Finally, it encourages a culture of responsibility and discipline among employees, fostering teamwork and accountability in maintaining a safe working environment.

4. (a) Safety refers to the condition of being protected from accidents, injuries, or harm in the workplace, while health hazard refers to a condition or substance that can cause illness or adverse health effects when a person is exposed to it.

   (b) When safety rules in the workshop are not observed, accidents and injuries such as cuts, burns, and electric shocks may occur. In addition, machines and tools may get damaged due to improper handling. Failure to observe safety also leads to disorganization, which increases the chances of hazards and reduces work efficiency.

   (c) Wearing safety glasses is important because it protects the eyes from flying particles, sparks, and dust during machining operations.

   Not wearing loose clothes prevents the risk of the clothes getting caught in rotating parts, which could lead to serious injuries.

   Keeping the machine and surrounding floor area clean helps prevent slips, falls, and contamination, ensuring smooth and safe operations.

   Stopping the machine before measuring work or cleaning prevents accidental contact with moving parts, reducing the risk of injuries.

   Not operating a machine until you understand its control ensures that the user can handle emergencies and operate safely, minimizing accidents.

   Not operating the machine if the machine guard is removed prevents exposure to dangerous moving parts, protecting the operator from harm.

5. (a) Mechanical properties of engineering materials refer to characteristics that describe how a material responds to mechanical forces. Examples include strength, hardness, toughness, ductility, and elasticity.

   Physical properties, on the other hand, describe measurable attributes that do not change the material's chemical composition. Examples include density, melting point, thermal conductivity, electrical conductivity, and color.

   (b) Physical strength of metals refers to their ability to withstand external mechanical forces without deformation or failure, while chemical strength refers to their resistance to chemical reactions such as corrosion or oxidation when exposed to environmental conditions like moisture or acids.

6. (a) The six main parts of an oxyacetylene welding plant are:
   - Oxygen cylinder
   - Acetylene cylinder
   - Pressure regulators
   - Hoses
   - Torch handle
   - Welding nozzle

   (b) Advantages of oxyacetylene welding include portability, allowing use in different locations; versatility, since it can weld various metals and thicknesses; and low initial equipment cost compared to other welding processes.

   Disadvantages include slower welding speed, limited suitability for very thick materials, and the potential risk of fire or explosion due to gas handling.

7. (a) The parts marked A-F of the oxyacetylene cutting blowpipe are:
   A. Oxygen inlet valve
   B. Acetylene inlet valve
   C. Mixer
   D. Cutting oxygen lever

E. Nozzle

F. Handle

(b) The main function of the part marked ‘C’ (mixer) is to combine oxygen and acetylene gases in proper proportion before combustion to produce a stable flame.

(c) If the mixer is removed, the gases will not mix properly, resulting in an unstable or incomplete flame that cannot cut effectively and may cause backfiring or safety hazards.

(d) The five procedures of lighting and adjusting the cutting blowpipe are:

(i) Open the oxygen and acetylene cylinder valves slightly to check for leaks.

(ii) Adjust both regulators to the required working pressure.

(iii) Open the acetylene valve on the torch and light it with a spark lighter.

(iv) Slowly open the oxygen valve to adjust the flame to neutral.

(v) Test the cutting oxygen lever and adjust for proper flame before starting to cut.

8. (a) Aluminium

Physical properties: It is lightweight and has good thermal and electrical conductivity.

Applications: Used in aircraft parts and cooking utensils.

(b) Copper

Physical properties: It has excellent electrical conductivity and good corrosion resistance.

Applications: Used in electrical wiring and water pipes.

(c) Lead

Physical properties: It is heavy and has high resistance to corrosion.

Applications: Used in batteries and radiation shielding.

(d) Silver

Physical properties: It has high electrical conductivity and an attractive luster.

Applications: Used in jewelry and electrical contacts.

(e) Zinc

Physical properties: It is bluish-white and has moderate strength with good corrosion resistance.

Applications: Used in galvanizing iron and manufacturing alloys such as brass.

9. (a) A mechanical hazard is a danger that arises from moving parts of machinery or tools that can cause injury to workers through contact, entanglement, or impact.

   (b) The four hazards considered mechanical hazards include rotating parts, sharp edges, cutting tools, and moving belts or chains.

   (c) Precautionary measures include wearing proper protective equipment, avoiding loose clothing near moving machinery, maintaining regular machine inspection, and keeping the work area clean and organized.

10. (a) When choosing the proper type of grinding wheel, the following criteria should be considered.

    First, the hardness of the material to be ground, since hard materials require soft wheels while soft materials need harder wheels.

    Secondly, the grain size should match the desired surface finish. Coarse grains are used for rough grinding while fine grains are used for smooth finishing.

    Thirdly, the bonding material should be chosen based on the type of grinding operation and speed, as it affects the wheel's strength and wear resistance.

    (b) Two grinding wheel defects include cracking and glazing. The remedy for cracking is proper handling and storage of wheels to prevent impact damage, while the remedy for glazing is dressing the wheel to expose new abrasive grains.

    (c) Abrasive materials or grit refer to hard substances used in grinding wheels to remove material from a workpiece through frictional contact. They determine the cutting ability and surface finish of the grinding process.

    (d) Examples of abrasive materials include aluminum oxide, which is used for grinding steel and iron, and silicon carbide, which is used for grinding non-ferrous metals and cast iron.