THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATIONS

131/2 **PHYSICS 2**

(For Both School and Private Candidates)

Duration: 3 Hours **Year: 2025**

Instructions

1. This paper consists of **six (6)** questions
2. Answer **five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Mathematics tables and non-programmable calculators may be used.
5. All writing must be in **black** or **blue** ink except for drawings which must be in pencil
6. Communication devices and any unauthorised materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet(s).
8. The following information may be useful:

    a) Acceleration due to gravity, $g = 9.8\ m/s^2$
    b) Pie, $\pi = 3.14$
    c) Speed of light, $c = 3 \times 10^8\ m\ s^{-1}$
    d) The coefficient of viscosity of water, $\eta = 10^{-3}\ N\ s\ m^{-2}$
    e) Speed of sound in still air = $340\ ms^{-1}$
    f) Charge of an electron, e, = $1.6 \times 10^{-19}\ C$
    g) Mass of an electron, $m_e = 9.0 \times 10^{-31}\ kg$
    h) Plank's constant, h, = $6.63 \times 10^{-34}\ Js$
    i) Permeability of free space, $\mu_o = 4\pi \times 10^{-7}\ Hm^{-1}$
    j) Reydberg constant, $R_H = 1.097 \times 10^7\ m^{-1}$

SECTION A (70 Marks)

Answer **all** questions from this section**.**

1. (a) (i) Account for a suction effect phenomenon based on Bernoulli's Theorem.

(ii) A raindrop of radius 2 mm falls from a height of 500 m above the ground with decreasing acceleration to half its original height. If it attains its maximum terminal speed and moves with uniform speed thereafter, determine the work done by the gravitational force on the drop in the first and second of its journey.

(b) (i) Distinguish between static pressure and dynamic pressure as applied in laminar fluid flow.

(ii) Water is flowing steadily through a horizontal pipe of uniform cross-sectional area. If the velocity and pressure at a point where cross section area is 0.02 m^2 are 2 m/s and 4 × 104 Nm^{-2}, respectively, calculate the pressure at a point where the cross-sectional area is reduced to 0.01 m^2.

(c) Determine the rate of flow of glycerine of density 1.25×10^3 kgm^3 through the cross section of a pipe if the radii at its ends and the pressure of a drop across its length are 0.1 m, 0.04 m and 10 N/m^2, respectively.

2. (a) (i) Determine the number of beats per second heard by the observer (assuming there was no wind), when a whistle gave a sound of frequency of 500 Hz moving away with the velocity of 1.5 m/s from a stationary observer in a direction towards and perpendicular to a flat wall.

(ii) Determine the width of the central maximum on a screen placed at a distance of 1 m from the slit, if the given slit width was 0.1 mm, and the slit was illuminated with a monochromatic light of wavelength of $5000\,\overset{0}{A}$

(b) (i) Calculate the frequency of the note when a wire of length 140 cm and mass was stretched by means of a load of 16 kg.

(ii) Estimate the positions where two bridges were to be placed to divide the wire into three segments whose fundamental frequencies were in the ratio of 1:2:3.

(c) (i) Identify the necessary conditions for interference of light to occur.

(ii) Explain briefly when Fraunhofer's diffraction takes place.

3. (a) (i) Explain why reducing the volume of a gas at constant temperature leads to an increase in pressure.

(ii) Deduce Avogadro's law in terms of the kinetic theory of gases.

(b) (i) Explain the terms root mean square speed and mean speed of gas molecules.

(ii) Determine the root mean square speed of a hydrogen molecule at a given temperature of 27° C, using the Boltzmann constant ($K = 1.38\times10^{-23}$J/K).

(c) State six assumptions that form the basic postulates of the kinetic theory of gases.

4. (a) (i) How is the direction of the field strength is specified?

(ii) Two point charge +2q should be placed between two-point charges A and B of +2q and -4q respectively are situated 90 mm apart. Where should a point charge of -2q be placed so that it experiences no resultant electrostatic force?

(b) (i) What are the common properties of electric field lines?

(ii) In demonstrating the motion of a charged particle, students considered an electron projected with an initial velocity of 10^7 into a uniform electric field between two parallel plates of length 2 cm being at a distance of 1 cm apart. If the direction of the field was vertically downwards when the electron just missed the upper plate as it emerges from the field, evaluate the magnitude of electric field.

(c) If a spherical conductor of radius 12 cm has a charge of 1.6×10^{-7} C distributed uniformly on its surface; calculate the electric field:

(i) Inside the sphere.

(ii) At a point from the sphere 18cm

5. (a) (i) Permanent magnets are made of steel while the core of a transformer is made of soft iron.

(ii) Like poles of nearly magnets repel each other while unlike poles attract.

(iii) Above Curie temperature ferromagnetic material becomes paramagnetic.

(b) (i) Distinguish between diamagnetic materials and ferromagnetic materials with one example in each case.

(ii) Describe the hysteresis loop for soft and hard steel with the aid of labelled sketches.

(c) (i) Calculate the force on the conductor carrying current of 5 A passing through it, when a vertical straight conductor of length 0.6 m is situated in a horizontal uniform magnetic field of 0.1 tesla.

(ii) Determine the angle through which the conductor must be substituted in the vertical plane so that the force on the conductor is halved.

6. (a) (i) explain a line spectrum based on the transition of electrons between energy levels and

(ii) calculate the ionisation energy of an element, when the energy of the convergence limit line of that element is -1.6 eV and that of the first energy level is -10.4 eV.

(b) (i) Evaluate the kinetic energy gained by electrons in the Xray tube, when the potential difference across its ends is 40 kV

(ii) determine the electric current flowing in the tube, when 0.5% of the energy obtained in 6 (b) (i) is transformed into X-rays and 600 W was produced.

(c) A beam of α -particles is directed normally at a thin metal foil in anα -scattering experiment. Briefly explain why;

(i) mostα -particles pass straight through the foil?

(ii) some α -particles are deflected through angles of more than 90^{o}?

(iii) multiple scattering of an individual α -particle is unlikely?