THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/2 **PHYSICS 2**

(For Both School and Private Candidates)

Time: 3 Hours **Year: 2023**

Instructions

1. This paper consists of a total of **six (6)** questions.
2. Answer **five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. All writing must be in **blue** or **black** ink **except** drawing which must be in pencil.
6. Cellular phones 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) Density of air $\rho_a = 1.29$ kg/m^3
   (d) Density of steel $\rho_s = 7800$ kg/m^3
   (e) Density of mercury $\rho_m = 13.6 \times 10^3$ kg/m^3
   (f) Density of water $\rho_w = 10^3$ kg/m^3
   (g) Density of oil $\rho_o = 900$ kg/m^3
   (h) Speed of sound, c = 340 m/s.
   (i) Permitivity of free space, $\varepsilon_o = 8.854 \times 10^{12}$ $Nm^{-2}kg^{-2}$.
   (j) Coefficient of viscosity of air = 1.8×10^{-5} Nsm^{-2}.
   (k) Pressure of air = 1.013×10^5 Pa.
   (l) Surface tension of water = 0.072 N/m
   (m) Permiability of free space, $\mu_0 = 4\pi \times 10^{-7}$ H/m
   (n) Plank's constant, h = 6.63×10^{-34} Js
   (o) Reydberg's constant = 1.1×10^7 m^{-1}
   (p) 1 a.m.u = 931 MeV.
   (q) Young's modulus of rubber, E = 6×10^8 N/m^2

1. (a) (i) What is meant by laminar flow as used in Fluid Dynamics? **(01 mark)**

(ii) State continuity equation for the incompressible fluid flowing through the pipe. **(01 mark)**

(iii) Identify two assumptions made to develop an equation in 1 (a) (ii). **(02 marks)**

(b) If 0.56 seconds was taken by a steel ball bearing a diameter of 8.0 mm to fall through oil at steady speed over a vertical distance of 0.2 m, determine:

(i) The weight of the ball. **(03 marks)**

(ii) The up thrust on the ball. **(03 marks)**

(iii) The viscosity of the oil. **(04 marks)**

(c) A large tank contains water to a depth of 1 m. If water emerges from the small hole in the side of the tank 20 cm below the level of the surface, calculate;

(i) The speed at which water emerges from the hole. **(03 marks)**

(ii) The distance from the base of the tank at which water strike the flow on which the tank is standing. **(03 marks)**

2. (a) (i) How does stationary wave differ from progressive wave? Give two points. **(02 marks)**

(ii) State the principle of superposition as applied in wave motion. **(02 marks)**

(iii) A plane progressive wave is represented by the equation; $y = 0.4\sin\left(200\pi t - \frac{20}{17}\pi x\right)$, where y is in metre and t in seconds. Determine the phase difference in radians between a point 0.25 m from the fixed point and a point 1.1 m from the same fixed point. **(04 marks)**

(b) (i) Why changes in pressure do not affect the velocity of sound? **(02 marks)**

(ii) At what temperature will the velocity of sound in air be twice than the velocity in air at $0\ ^0C$? **(03 marks)**

(c) (i) Why does an empty vessel produces more sound than a filled one? **(02 marks)**

(ii) A closed organ pipe is of length 0.68 m. Compute the wavelengths and frequencies of the three lowest frequency modes of vibrations. **(05 marks)**

3. (a) (i) What is meant by the terms modulus of elasticity and modulus of rigidity as used in properties of matter? **(02 marks)**

(ii) An aluminium cube of dimensions $4\,cm \times 4\,cm \times 4\,cm$ is subjected to a tangential force. If its top face is sheared by a length of 0.012 cm with respect to the bottom; calculate the shearing strain and shearing stress given that the modulus of rigidity of aluminium is $2.08 \times 10^{10}\,N/m^2$. **(04 marks)**

(b) A rubber cord of a catapult having a cross-sectional area of 2 mm^2 and initial length of 0.2 m is stretched to 0.24 m in order to fire a small object of mass 10 g. Compute:

(i) The energy stored in the rubber. **(03 marks)**

(ii) The initial velocity of the object as it just leaves the catapult. **(03 marks)**

(c) (i) Briefly explain the classification of materials based on their elastic properties. **(06 marks)**

(ii) Why do spring balances show wrong readings after they have been used for a long time? **(02 marks)**

4. (a) (i) Distinguish between electric dipole and dipole field. **(02 marks)**

(ii) An electric dipole consists of two charges of $+20\ \mu C$ and $-20\ \mu C$ separated by a small distance of '$2a$' in free space. Calculate the electric field intensity at a point on the axial line of the dipole at a distance of 10 cm from the centre of the dipole. **(04 marks)**

(b) (i) Figure 1 shows two points A and B lying between electric lines of force emerging from a charged body.

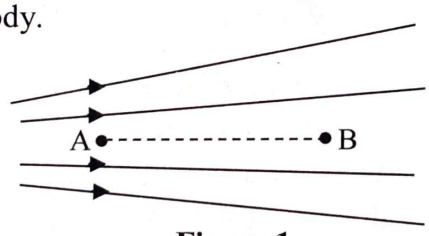

Figure 1

At which point should an electric field intensity expected to be high? Give reason for your answer. **(03 marks)**

(ii) A charged plastic ball of mass 8.4×10^{-16} kg is found to remain suspended in a uniform electric field of 2.6×10^{4} V/m. Find the charge on the ball. **(04 marks)**

(c) (i) What is meant by the term electric potential? **(02 marks)**

(ii) Calculate the electric potential at the surface of a silver nucleus of radius 3.4×10^{-14}m given that the atomic number of silver and charge 'e' on proton are 47 and 1.6×10^{-16}C respectively. **(05 marks)**

5. (a) (i) Briefly explain the production of magnetic field in a moving coil galvanometer. **(02 marks)**

(ii) How does a wire carrying current differ from another wire carrying no current? **(02 marks)**

(b) (i) What are the four factors which affect the magnitude of force exerted by magnetic field on the charge? **(04 marks)**

(ii) With the aid of a well labeled diagram, describe the principle, construction and mode of action of a moving coil galvanometer. **(06 marks)**

(c) (i) Why does a current carrying conductor experience a force in a magnetic field? **(02 marks)**

(ii) Calculate the strength of magnetic field produced if a force of 1.09×10^{-11} N is acting on a proton which enters a magnetic field with a speed of 3.4×10^{7} m/s in a direction perpendicular to the field. **(04 marks)**

6. (a) (i) Explain how stability of an atom is related to its binding energy. **(02 marks)**

(ii) A nuclear reaction is given by the equation, ${}^{7}_{3}\text{Li}+{}^{1}_{1}\text{H}\rightarrow 2{}^{4}_{2}\text{He}+17.3\,\text{MeV}$. Find the mass of ${}^{4}_{2}\text{He}$ in a.m.u given that the mass of ${}^{7}_{2}\text{Li}$ and ${}^{1}_{1}\text{H}$ are 7.0186 a.m.u and 1.00813 a.m.u respectively. **(05 marks)**

(b) (i) Why neutron is a most effective bombarding particle in nuclear reactions? **(02 marks)**

(ii) The half life of a radioactive substance is 30 days. Determine the time taken for $\frac{3}{4}$ of its original mass to disintegrate. **(04 marks)**

(c) In an experiment to account for the photoelectric effect phenomenon students noted some electrons in hydrogen – like atoms (Z = 3) making transition from fifth to fourth orbit and from fourth to third orbit such that the resulting radiations were incident normally on a metal plate ejecting photoelectrons. If the stopping potential for the photoelectrons ejected by shorter wavelength is 3.96 V; determine:

(i) The work function of the metal. **(04 marks)**

(ii) The stopping potential for the photoelectrons ejected by longer wavelength. **(03 marks)**