

**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 $g = 9.8 \text{ m/s}^2$
 - (b) Pie $\pi = 3.14$
 - (c) Density of air $\rho_a = 1.29 \text{ kg/m}^3$
 - (d) Density of steel $\rho_s = 7800 \text{ kg/m}^3$
 - (e) Density of mercury $\rho_m = 13.6 \times 10^3 \text{ kg/m}^3$
 - (f) Density of water $\rho_w = 10^3 \text{ kg/m}^3$
 - (g) Density of oil $\rho_o = 900 \text{ kg/m}^3$
 - (h) Speed of sound, $c = 340 \text{ m/s}$.
 - (i) Permittivity of free space, $\epsilon_0 = 8.854 \times 10^{12} \text{ Nm}^{-2}\text{kg}^{-2}$.
 - (j) Coefficient of viscosity of air $= 1.8 \times 10^{-5} \text{ Nsm}^{-2}$.
 - (k) Pressure of air $= 1.013 \times 10^5 \text{ Pa}$.
 - (l) Surface tension of water $= 0.072 \text{ N/m}$
 - (m) Permiability of free space, $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$
 - (n) Plank's constant, $h = 6.63 \times 10^{-34} \text{ Js}$
 - (o) Reydberg's constant $= 1.1 \times 10^7 \text{ m}^{-1}$
 - (p) 1 a.m.u $= 931 \text{ MeV}$.
 - (q) Young's modulus of rubber, $E = 6 \times 10^8 \text{ N/m}^2$



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 °C? **(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 × 4 cm × 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 $2.08 \times 10^{10} \text{ N/m}^2$. **(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:
- The energy stored in the rubber. (03 marks)
 - 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 $+20 \mu\text{C}$ and $-20 \mu\text{C}$ 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.

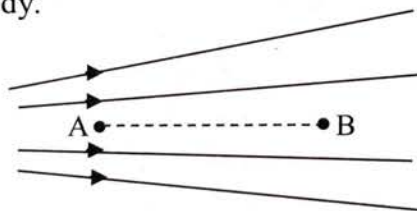


Figure 1

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 $8.4 \times 10^{-16} \text{ kg}$ is found to remain suspended in a uniform electric field of $2.6 \times 10^4 \text{ V/m}$. 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 $3.4 \times 10^{-14} \text{ m}$ given that the atomic number of silver and charge ' e ' on proton are 47 and $1.6 \times 10^{-16} \text{ C}$ 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 $1.09 \times 10^{-11} \text{ N}$ is acting on a proton which enters a magnetic field with a speed of $3.4 \times 10^7 \text{ m/s}$ 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 ${}^7_3\text{Li}$ 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)**