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: 2024**

Instructions

1. This paper contains 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** drawings which must be in pencil.
6. Communication devices and any other unauthorized 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 $g = 9.8\ ms^{-2}$

(b) Pie, $\pi = 3.14$

(c) Speed of light, $c = 3.0 \times 10^{8}\ m\ s^{-1}$

(d) The coefficient of viscosity of water, $\eta = 10^{-3}\ N\ s\ m^{-2}$

(e) Speed of sound in still air = $340\ m\ s^{-1}$

(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) Planck's constant, $h = 6.63 \times 10^{-34}\ Js$

(i) Permeability of free space, $\mu_0 = 4\pi \times 10^{-7}\ H\ m^{-1}$

(j) Reydberg constant, $R_H = 1.097 \times 10^{7}\ m^{-1}$

(k) Young's modulus of brass $E_B = 1.0 \times 10^{11}\ N/m^2$

(l) Young's modulus of iron $E_{Fe} = 1.8 \times 10^{11}\ N/m^2$

(m) Permitivity of free space, $\varepsilon_o = 8.85 \times 10^{12}\ Nm^{-2}kg^{-2}$

1. (a) (i) What is meant by the term viscosity as applied in fluid dynamics? **(02 marks)**

(ii) Distinguish between streamline flow and turbulent flow of a liquid. Give two points. **(03 marks)**

(b) (i) Identify the principle on which the continuity equation is based? **(01 mark)**

(ii) Why does the velocity increases when water flowing in broader pipe enters a narrow pipe? **(02 marks)**

(c) (i) Briefly explain how the viscosities of two liquids can be compared. **(03 marks)**

(ii) Water flows through a horizontal tube of diameter 0.008 m and a length of 4 km at the rate of 20 litres per second. Assuming that only viscous resistance exist, estimate the pressure difference required to maintain the flow. **(05 marks)**

(d) A horizontal pipe of diameter 20 cm has constriction of diameter 4 cm along its length. If the velocity and pressure of water flowing through it is 2 m/s and 10^7 N/m^2 respectively; determine the pressure at the constriction. **(04 marks)**

2. (a) (i) Stipulate two distinctive properties between travelling and standing waves. **(02 marks)**

(ii) Sound wave of wavelength λ travel from the first medium with a velocity of v into another medium with the velocity of $4v$. Determine the wavelength of sound wave in the second medium. **(03 marks)**

(b) (i) State the principle of superposition as applied to wave motion. **(01 mark)**

(ii) Analyse five differences between interference and diffraction based on superposition of light waves. **(05 marks)**

(c) The transverse displacement of a string which is clamped at its both ends is given by the equation, $y(x, t) = 0.06 \sin\left(\frac{2\pi}{3}x\right)\cos(120\pi t)$, where x and y are in metres and t in seconds. If the length and mass of the string are 1.5 m and 3.0×10^{-2} kg respectively;

(i) What type of the wave does the equation represent? **(04 marks)**

(ii) Determine the tension in the string. **(05 marks)**

3. (a) (i) How is brittle materials differ from ductile materials? **(02 marks)**

(ii) Figure 1 is a sketch graph of force, F against extension, e for two iron wires, X and Y of the same length, l.

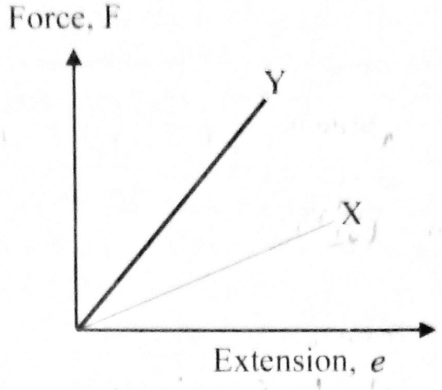

Figure 1

Which wire is expected to extend more when both are subjected to a constant force? Give a reason for your answer. **(04 marks)**

(b) (i) A uniform iron bar of diameter 8.0 mm and initial length 500 mm is heated uniformly until it expands by 0.4 mm. If it is later clamped at its ends and allowed to cool; calculate the tension in the bar. **(04 marks)**

(ii) Compute the increase in energy of the brass bar of length 0.2 m and cross sectional area 1 cm^2 when compressed with a force of 49 N along its length. **(04 marks)**

(c) (i) Why springs are made of steel and not copper? **(02 marks)**

(ii) A copper rod of length 2 m and cross-sectional area 2.0 cm^2 is fastened end to end to a steel rod of length L and cross-sectional area 1.0 cm^2. If the compound rod is subjected to equal and opposite pulls of magnitude 3×10^4 N at its ends and the elongations of the two rods are equal, find the length, L of the steel rod given that the Young's modulus of steel and copper are 1.2×10^{11} N/m^2 and 2×10^{11} N/m^2 respectively. **(04 marks)**

4. (a) (i) Identify three important properties of equipotential surface. **(03 marks)**

(ii) Two protons in a nucleus of U^{238} are separated by 6.0×10^{-15} m. Determine their mutual electric potential energy. **(03 marks)**

(b) (i) Derive an expression for the energy stored inside a charged capacitor. **(04 marks)**

(ii) A $10\times10^6\ \Omega$ resistor is connected in series with a capacitor of 1.0 μF and a battery of e.m.f. 12.0 V. If before the switch is closed the capacitor is uncharged; find the fraction of the final charge on the plates and of the initial current remains at time t = 46 seconds. **(06 marks)**

(c) A uniformly charged conducting sphere of diameter 2.4 m has a surface charge density of 80 $\mu C/m^2$. Determine;

(i) The charge on the sphere. **(02 marks)**

(ii) The total electric flux leaving the surface of the sphere. **(02 marks)**

5. (a) (i) Distinguish between magnetic flux density and magnetic field intensity. **(02 marks)**

(ii) Calculate the maximum electromotive force (e.m.f) induced in a coil of 500 turns, each with an area of 4.0 cm^2 making 50 revolutions per second in a uniform magnetic field of flux density 0.04 T. **(03 marks)**

(b) A wire of 2.0 metres long carrying a current of 10 A is placed in a field of flux density 0.15 T. Determine the force on the wire if it is placed;

(i) At right angle to the field. **(03 marks)**

(ii) At 45 degrees to the field. **(01 mark)**

(iii) Along the field. **(02 marks)**

(c) (i) State Lenz's law of electromagnetic induction. **(02 marks)**

(ii) Two identical wires R and S lie parallel in a horizontal plane, their axes being 0.1 m apart. If the current of 10 A flows in wire R in the opposite direction to a current of 30 A in wire S; calculate the magnitude and direction of magnetic flux density at point P midway between R and S. (Neglect the effect of the earth's magnetic flux density). **(07 marks)**

6. (a) (i) Analyse two drawbacks on which Bohr's model of an atom suffered. **(02 marks)**

(ii) State two differences between Rutherford's model and Bohr's model. **(04 marks)**

(b) (i) What do you think would really happen if the electrons in an atom were stationary? **(02 marks)**

(ii) A single electron rotates around a stationary nucleus of charge Ze, where 'Z' and 'e' are constant and electronic charge respectively. If it requires 47.2 eV to excite an electron from the second Bohr's orbit; determine the value of Z. **(06 marks)**

(c) (i) Which series of hydrogen spectrum lie in the visible region of electromagnetic spectrum? **(02 marks)**

(ii) Hydrogen atoms in a discharge tube emit spectral lines whose frequencies are given by the following equation, $f = CR_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ where n_1 and n_2 are any positive whole numbers. Calculate the highest frequency in the Lyman's series. **(04 marks)**