CHRISTIAN SOCIAL SERVICES COMMISSION (CSSC)

NORTHERN ZONE JOINT EXAMINATIONS SYNDICATE (NZ-JES)

FORM SIX PRE-NATIONAL EXAMINATIONS 2026

PHYSICS 2

131/2

Time: 3:00 Hours **Monday, 2nd March 2026 a.m**

Instructions

1. This paper consists of **six (6)** questions.
2. Answer **any five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorized materials are not allowed in the examination room.
6. Write your **examination number** on **every page** of your answer booklet(s)
7. The following information may be useful:
   - Acceleration due to gravity, g = 9.8m/s
   - Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$
   - Universal molar gas constant = 8.31 $Jmol^{-1}$ K^{-1}
   - Planck's, h= $6.64 \times 10^{-34} Js$
   - Permittivity of free space = $8.85 \times 10^{-12} Fm^{-1}$
   - Boltzmann's constant K = $1.38 \times 10^{-23} JK^{-1}$
   - Avogadros Number $Na = 6.02 \times 10^{2m} mol^{-1}$
   - Atmospheric pressure = 1.01 x $10^5 N/m^2$
   - Density of air = 1.29 kgm^{-3}
   - Density of water = 1000 kgm^{-3}
   - Shear Modulus of Lead = 5.6 x $10^9 N/m^2$
   - Speed of sound in air = 340ms-1

1. (a) Differentiate between the following:
   (i) Disorderly flow and steady flow. **(02 marks)**
   (ii) Compressible fluid and incompressible fluid. **(02 marks)**
   (iii) Critical velocity and terminal velocity **(02 marks)**

   (b) (i) Explain the principle on which continuity equation is based. **(02 marks)**
   (ii) A pipe is running full of water, at a certain point A, it tapers from 60 cm diameter to 20cm at B, the pressure difference between A and B is 100 cm of water column. Find the rate of flow through the pipe. **(03 Marks)**

   (c) (i) State the Bernoulli's theorem **(02 marks)**
   (ii) in horizontal pipeline of uniform area of cross-section, the pressure falls by $5N/m^2$ between two points separated by a distance of 1 km. what is the change in kinetic energy per kg of the oil of density $800kgm^{-3}$ flowing at these points? **(03 marks)**

   (d) Water is coming out of a hole made in the wall of a water tank. The level of water in the tank is being kept constant. If the size of the hole is increased, what will be the
   (i) Change in velocity of efflux of water **(02 marks)**
   (ii) Volume of water coming out per second **(02 marks)**

2. (a) (i) Explain what is meant by two wave trains being in phase **(01 marks)**
   (ii) What is a plane progressive wave? **(01 marks)**
   (iii) If a plane progressive wave is represented by the equation $y = Asin2\pi\left(\frac{B}{h} - \frac{C}{h}\right)$, what the quantities A,B and C physically represent?

   (b) If the wave in 2a(iii) above is represented by equation $y = A\ sin200\pi\left(10t - \frac{x}{1700}\right)$, where t in seconds and y in cm, calculate;
   (i) Wavelength λ, Velocity V and period T **(03 marks)**
   (ii) Phase difference between points 2cm apart **(01 marks)**

   (c) (i) Explain Doppler's principle and its application **(02 marks)**
   (ii) Ultrasound of frequency 4MHz is incident at angle of 30° to a blood vessel of diameter 1.6mm.If a Doppler shift of 3.2KHz is observed. Calculate the blood flow velocity and volume rate of blood flow. Assume that speed of ultrasound is 1.5Km per second. **(04 Marks)**

   (d) A set of Newton's ring between one surface of biconvex lens and glass plate using a green light of wavelength 5460Å. The diameters of two particular bright rings of orders of interference p and p+10 were found to be 5.72mm and 8.10mm respectively. When the space between the lens surface and the plate was filled with liquid the corresponding values were 4.95mm and 7.02mm. Determine the radius of curvature of the lens surface and refractive index of the liquid. **(05 Marks)**

3. (a) (i) State the kinetic theory of gases. **(02 marks)**
   (ii) Outline four assumptions made in deriving the kinetic theory of gas equation

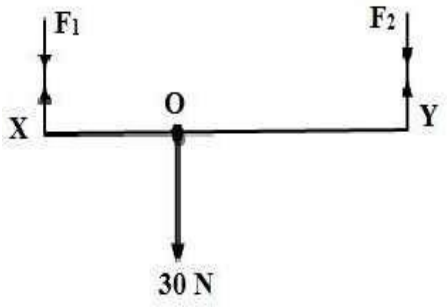
   $$\boldsymbol{P = \frac{1}{3}\,\bar{p}\,e^2}$$ **(02 marks)**

   (iii) An oxygen cylinder of volume 30litres has an initial gauge pressure of 15atm and a temperature of $27^{o}C$. After some oxygen is withdrawn from the cylinder, the gauge pressure drops to 11atm and its temperature drops to $17^{o}C$. Estimate the mass of oxygen taken out of the cylinder. **(04 marks)**

   (b) (i) Distinguish mean free path from collision frequency. **(02 marks)**
   (ii) Argon has a molecular diameter about $3\,A$. Estimate the mean free path, collision frequency and root mean square speed for 1 mole argon at S.T.P. **(03 marks)**

(c) (i) Define tensile force. **(01 marks)**

(ii) Two vertical wires X and Y, suspended at the same horizontal level, are connected by a light rod XY at their lower ends, as shown in the fig.02 below. The wires have the same length l and cross-section area A. A weight of 30 N is placed at point O on the rod, where XO: OY=1:2, both wires are stretched and the rod XY then remains horizontal. If the wire X has a Young modulus $E_X = 1.0x10^{11}$ Pa, calculate the Young modulus E_Y of the wire Y assuming the elastic limit is not exceeded for both wires. **(06 marks)**



4. (a) (i) Identify two limitations of Coulomb's law **(02 marks)**

(ii) Two identically charged spheres are suspended by strings of equal length. The strings make an angle of 30° with each other. When suspended in liquid of density $0.8gcm^{-3}$, the angle remains the same. What is dielectric constant of liquid, the density of material of sphere is $1.6g/cm^3$. **(06 marks)**

(b) (i) In a hydrogen atom, the distance between electron and proton is 0.53Å. Taking zero of potential energy at infinite separation of electron and proton, calculate the potential energy of the system in electro- volts **(03 marks)**

(ii) Assuming that the kinetic energy of the orbit in (b)(i) above, is half the magnitude of potential energy , what is the minimum amount of work in electro-volts required to free the electron? **(03 marks)**

(c) The plates of a parallel plate air capacitor consisting of two circular plates, each of 10 cm radius, placed 2 mm apart, are connected to the terminals of an electrostatic voltmeter. The system is charged to give a reading of 100 on the voltmeter scale. The space between the plates is then filled with oil of dielectric constant 4.7 and the voltmeter reading falls to 25.

(i) Calculate the capacitance of the voltmeter. **(04 marks)**

(ii) State the assumptions made in arriving to the answer. **(02 marks)**

5. (a) (i) Define magnetic force and magnetic field strength and give the S.I unit of magnetic field strength **(03 marks)**

(ii) A long straight wire is positioned perpendicular to a uniform magnetic field of strength 2.0×10^{-5} T. If there is a current of 1 A in the wire, what will be the total magnetic field at points A and B in figure 1.0 below? **(04 marks)**

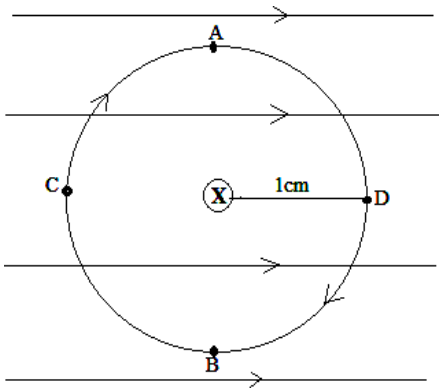


Figure 1.0

(b) (i) State Lenz's law of electromagnetic induction **(02 mark)**

(ii) At what rate would it be necessary for a single conductor to cut the flux in order that a current of 1.2 mA flows through it when 10Ω resistor is connected across its ends? **(04 marks)**

(c) A beta particle moves in a uniform magnetic field with an induction of 1.2 Tesla ina circle of radius 49 cm in a plane perpendicular to the lines of force. Find

(i) The speed of the particle **(03 marks)**

(ii) The kinetic energy of the particle **(02 marks)**

(d) Briefly explain the following terms

(i) Curie's temperature **(01 mark)**

(ii) Hysterisis loop **(01 mark)**

6. (a) (i) in photoelectric effect, do all electrons that absorbs a photon come out as photo electrons irrespective of their locations? Explain. **(02 mark)**

(ii) A source of light of frequency greater than threshold frequency is placed at distance d from cathode of a photocell. The stopping potential is found to be V. if distance of light source is reduced to ^{d} (where n > 1), explain the changes that are likely to be observed in the Photoelectric current and Stopping potential. **(03 marks)**

(b) (i) Why are the energies of various energy levels of hydrogen are negative? **(01 mark)**

(ii) It is found experimentally that 13.6 eV energy is required to separate a hydrogen atom into proton and an electron. Compute the orbital radius and the velocity of the electron in a hydrogen atom. **(05 marks)**

(c) (i) Define binding energy and mass defect of an atom. **(02 marks)**

(ii) Calculate the binding energy of the Helium atom which consist of 2 proton, 2 neutrons and 2 electrons. **(03 marks)**

Mass of Helium atom = 4.002600u, Mass of proton, m_p = 1.00728u, mass of neutrons =1.00867u, mass of electron, m_e = 0.00055u, 1u = 932 MeV

(d) Calculate the energy released when 10 kg of $^{235}_{36}UU$ undergoes ion according to;

$$^{235}_{36}U + {}^{1}_{0}n \quad {}^{141}_{56}Ba + {}^{92}_{36}Ka + 3{}^{1}_{0}n$$

Given Mass of $^{235}_{36}U$= 235.04u, Mass of $^{143}_{56}Ba$ = 140.91u. Mass of $^{97}_{36}Kr$ = 91.91u, Mass of $^{1}_{0}n$ = 1.01u, 1u = 932MeV and Na = $6.0 \times 10^{23}\ mol^{-1}$ **(03 marks)**