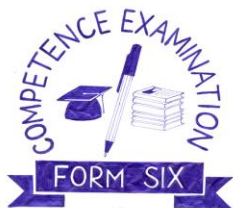


THE PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
FORM SIX COMPETENCE EXAMINATIONS (FOSCE) -2025



CODE: 131/2

PHYSICS 2

TIME: 3 HOURS

25TH FEBRUARY 2025, PM

INSTRUCTIONS:

1. This paper consists of **Six (6)** questions and each question carries **twenty (20)** marks.
2. Answer **FIVE (5)** questions.
3. All working must be shown clearly on how you arrived at the answer.
4. Mathematical tables and non-programmable calculators may be used
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklets.
7. The following information may be useful:
 - (a) Acceleration due to gravity, $(g) = 9.8 \text{ m/s}^2$
 - (b) Young's modulus of copper wire, $(E) = 1.2 \times 10^{11} \text{ N/m}^2$
 - (c) $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$
 - (d) Permeability of free space, $(\mu_0) = 4\pi \times 10^{-7} \text{ H/m}$
 - (e) Electronic charge, $(e) = 1.6 \times 10^{-19} \text{ C}$
 - (f) Planck's constant, $(h) = 6.63 \times 10^{-34} \text{ Js}$
 - (g) Avogadro's number, $(N_A) = 6.02 \times 10^{23} \text{ per mole}$
 - (h) Speed of light in vacuum, $(c) = 3 \times 10^8 \text{ m/s}$
 - (i) Permittivity of free space, $(\epsilon_0) = 8.85 \times 10^{-12} \text{ F/m}$
 - (j) Mass of proton $(m_p) = 1.67 \times 10^{-27} \text{ kg}$
 - (k) Charge of electron, $e = 1.6 \times 10^{-19} \text{ C}$
 - (l) Mass of neutron $(m_n) = 1.675 \times 10^{-27} \text{ kg}$
 - (m) Density of Copper $= 9000 \text{ kgm}^{-3}$
 - (n) Specific heat capacity of Copper $= 390 \text{ Jkg}^{-1} \text{ K}^{-1}$

1. (a) (i) What are the three applications of fluid dynamics in daily life. **(03 marks)**
 (ii) For the same applied force in honey and water, the rate of flow of honey will be less than that of water. Explain why? **(02 marks)**
- (b) A cylindrical tank of 10 cm in radius rests on platform 5 m high. Initially, the tank was filled with water to a height of 5 m. If the plug of area $1 \times 10^{-4} \text{ m}^2$ is removed by an orifice on the side of the tank at the bottom. Calculate:
 (i) The initial speed with which water flows from the orifice. **(03 marks)**
 (ii) The speed with which water strikes the ground. **(03 marks)**
- (c) (i) Use the Poiseuille's theorem to show that the height of the liquid at any particular point of the volume at any time is $h = h_0 e^{-ct}$, whereby h is the final height of the liquid, h_0 is the original height of the liquid, t is the time taken by the liquid to flow and c is constant. **(04 marks)**
 (ii) Two tubes AB and BC of the same length and having radii of 2 mm and 1 mm respectively are joined end to end at B, a liquid flows through them and the difference between A and C is 340 mmHg. What is the difference in pressure between B and C? **(05 marks)**
2. (a) (i) Briefly explain how standing wave is formed on a string? **(02 marks)**
 (ii) Mention two factors affecting frequency in a string. **(02 marks)**
- (b) A string under tension is observed to vibrate with a frequency of 40Hz in its fundamental mode, when the supports are 0.6 m apart. The amplitude of the note is 3cm. If the string has a mass of 30g, calculate:
 (i) The velocity of propagation of the transverse wave in string. **(03 marks)**
 (ii) The tension in the string. **(03 marks)**
- (c) (i) By means of equation or expression show how the temperature and density affect the velocity of sound waves in air. **(06 marks)**
 (ii) Ultra sound of frequency f is incident to a blood vessel of a patient at an angle θ . The sound is from a transducer that sends Ultrasound and detects the sound reflected from a blood vessel of a diameter d . Derive an expression for the volume flow rate Q of the blood in patient's blood vessel. **(04 marks)**
3. (a) (i) Differentiate between surface tension and surface energy. **(02 marks)**
 (ii) Briefly explain why a steel needle when placed on water surface may float however when detergents are added to water it may sink. **(02 marks)**
- (b) (i) Prove that Young's modulus of the wire is equal to the stress necessary to double its length. **(02 marks)**
 (ii) A 20kg weight is suspended from a copper wire of 1mm in radius. If the wire breaks suddenly, find the change in temperature. **(06 marks)**
- (c) (i) On the basis of kinetic theory of gas, show that two different gases at the same temperature will have the same average kinetic energy. **(04 marks)**
 (ii) A cylinder contains 5kg of a gas at a pressure of $1 \times 10^7 \text{ Nm}^{-2}$. Some quantity of the gas is taken out and its pressure decreases to $2 \times 10^6 \text{ Nm}^{-2}$. What is the quantity of the gas taken out if the temperature of the gas is kept constant? **(04 marks)**

4. (a) (i) Electrostatic experiment cannot be conducted successfully on a humid day. Explain. **(02 marks)**
- (ii) Three point charges q , $2q$ and $3q$ are placed on 9cm long straight line. Find the positions where the charges should be placed such that potential energy of the system is minimum. **(04 marks)**
- (b) (i) Coulomb's law and Gauss's law are equivalent. What are areas of application of these laws? **(02 marks)**
- (ii) Briefly explain, does Coulomb's law of electric force obey Newton's third law of motion? **(02 marks)**
- (iii) Sketch a graph showing variation of electric field intensity with distance from the centre for a hollow sphere. Comment on your graph. **(04 marks)**
- (c) A 300 pF capacitor is charged to a p.d of 50 V and then discharged through 500 Ω resistor.
- (i) Find the initial discharge current. **(02 marks)**
- (ii) How long it will take for the p.d across the capacitor to fall to 2% of its original value. **(03 marks)**
- (iii) What is the value of time constant? **(01 mark)**
5. (a) (i) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials on the basis of relative permeability μ_r . **(03 marks)**
- (ii) What are the three independent quantities which are conventionally used to describe the magnetic field on the earth's surface? **(03 marks)**
- (b) (i) Why the material used for making the core of a transformer should have narrow hysteresis loop? **(02 marks)**
- (ii) A specimen of iron is uniformly magnetized by the magnetizing field of 300 Am^{-1} . If the magnetic flux density in the specimen is 0.4 Wbm^{-2} , find the relative permeability, susceptibility and the permeability of the specimen. **(06 marks)**
- (c) Two identical wires R and S lie parallel in a horizontal plane, the axis being 10 cm apart. A current of 10 A flows in R and in the opposite direction to a current of 30 A flows in S. Neglecting the effect of the earth's magnetic flux density, calculate the magnitude of B at a point P in the plane of the wire, if P is;
- (i) Midway between R and S. **(03 marks)**
- (ii) 5 cm from R and 15 cm from S. **(03 marks)**
6. (a) (i) What are the main two differences between Rutherford's and Bohr's model of an atom? **(02 marks)**
- (ii) How does photon theory explain photoelectric effect? **(02 marks)**
- (b) (i) Show that de Broglie hypothesis of matter agrees with Bohr's theory. **(03 marks)**
- (ii) Calculate wavelength of most energetic x-rays produced by a tube operating at $1 \times 10^5 \text{V}$. **(04 marks)**
- (c) (i) Briefly explain why the mass of the nucleus is less than the sum of the masses of the electrons forming it? **(03marks)**
- (ii) There is a stream neutron with kinetic energy of 0.032eV. If the half-life of neutrons is 700s. What fraction of neutrons will remain undecayed before they travel a distance of 10m? **(06 marks)**