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

131/2 **PHYSICS 2**
(For Both School and Private Candidates)

Time 3 Hours **Year: 2020**

Instructions

1. This paper consists 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. 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:

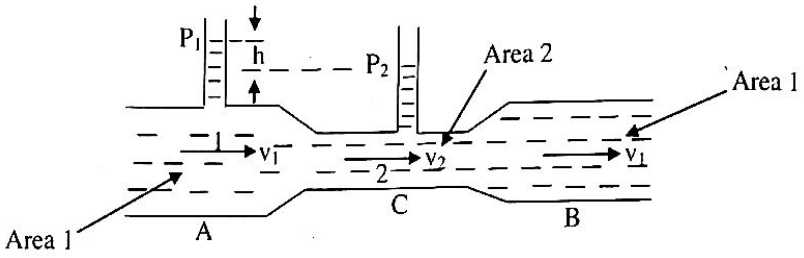
   (a) Acceleration due to gravity, $g = 9.8\ m/s^2$
   (b) Pi, $\pi = 3.14$
   (c) Avogadro's Number, $N_A = 6.0x10^{23}\ mol^{-1}$
   (d) Density of water $= 10^3\ kg/m^3$
   (e) Charge of electron $= 1.6 \times 10^{-19} C$
   (f) 1 Year $= 3.15 \times 10^7 s$
   (g) 1 MeV $= 1.6 \times 10^{-13} J$
   (h) Permeability of free space, $\mu_O = 4\pi \times 10^{-7}\ Hm^{-1}$
   (i) Mass of electron $m_e = 9.1 \times 10^{-31}$ kg
   (j) Permittivity of free space, $\varepsilon_O = 8.854 \times 10^{-12}\ Fm^{-1}$
   (k) Relative permittivity of air $\varepsilon_r = 1$
   (l) Surface tension of water, $T = 0.072\ Nm^{-1}$
   (m) Mass of ${}^{2}_{1}H = 3.345 \times 10^{-27}$ kg, ${}^{3}_{1}H = 5.008 \times 10^{-27}$ kg, ${}^{4}_{1}He = 6.647 \times 10^{-27}$ kg and ${}^{1}_{0}n = 1.675 \times 10^{-27}$ kg

Answer **five (5)** questions.

1. (a) State two factors which determine the magnitude of viscous force. **(02 marks)**

(b) Identify two limitations and three importances of applying Stokes' law in fluids motion. **(05 marks)**

(c) A venture meter consists of two identical wide tubes A and B connected by a narrow tube C. The liquid enters through the wide tube A and after passing through the narrow tube C leaves through the other wide tube B. The entire arrangement is as shown in the following Figure.



Use the Bernoulli's theorem at points 1 and 2, to show that an expression for the rate of flow of the liquid is given by $Q = A_1A_2\sqrt{\frac{2gh}{A_1^2-A_2^2}}$, where all symbols carry their usual meaning. **(06 marks)**

(d) A cylindrical tank 1 m in radius rests on a platform 5 m high. Initially, the tank was filled with water to a height of 5 m. If a plug of area $10^{-4}m^2$ is removed by an orifice on the side of the tank at the bottom; calculate the initial speed with which the water:

(i) flows from the orifice. **(04 marks)**

(ii) strikes the ground. **(03 marks)**

2. (a) What is the importance of each of the following in relation to the production of plane polarized light?

(i) Dextro-rotatory substance. **(01 mark)**

(ii) Laevo-rotatory substance. **(01 mark)**

(iii) Optically active substance. **(01 mark)**

(iv) Double refraction. **(01 mark)**

(b) Differentiate:

(i) Polaroid from polarimeter. **(01 mark)**

(ii) Plane of vibration from plane of polarization. **(01 mark)**

(iii) Ordinary light from plane polarized light. **(01 mark)**

(c) Describe the construction of Nicol Prism. **(05 marks)**

(d) Briefly explain the observations made with regard to the formation of fringes in Newton's ring experiment when:

(i) the glass plate is silvered on its front surface. **(02 marks)**

(ii) the sodium lamp is replaced by a white light. **(02 marks)**

(iii) a few drops of a transparent liquid are introduced between the lens and the plate. **(02 marks)**

(e) What governs the radius of the ring in Newton's ring experiment? Give two factors. **(02 marks)**

3. (a) Briefly explain the following observations:
   (i) The rise of the liquid is affected if the top of the capillary tube is closed. **(02 marks)**
   (ii) Rain drops are spherical in shape. **(02 marks)**

   (b) (i) Why brick walls are plastered with cement? **(03 marks)**
   (ii) A barometer contains two uniform capillary tubes of radii 6.5×10^{-4} m and 1.24×10^{-3} m. If the height of water in a narrow tube is 0.2 m more than that in the wide tube, calculate the true pressure difference. **(05 marks)**

   (c) (i) What is meant by surface tension? Give its S.I. units. **(02 marks)**
   (ii) During the rain, 64 rain drops combined into a single drop. Calculate the ratio of the total surface energy of the 64 drops to that of a single drop. **(06 marks)**

4. (a) (i) Give the meaning of the terms capacitance and relative permittivity. **(02 marks)**
   (ii) Calculate the capacitance of a pair of parallel plates 0.1 m by 0.1 m with an air gap of 5 mm. **(04 marks)**

   (b) (i) What is a Van de Graaff generator? **(02 marks)**
   (ii) In a Van de Graaff generator, the shell electrode is at 25×10^5 V. If the dielectric strength of the gas surrounding the electrode is 5×10^7 V/m, calculate the minimum radius of the spherical shell. **(04 marks)**

   (c) (i) State Coulomb's law of forces. **(02 marks)**
   (ii) An electron is situated in a uniform electric field of field strength of 1.2×10^5 Vm^{-1}. Find the force acting on it and its acceleration if it has travelled 20 mm from rest. **(06 marks)**

5. (a) (i) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials on the basis of relative permeability μ_r. **(03 marks)**
   (ii) Give the meaning of magnetization I for a paramagnetic material and use Curie's law to show how it relates with the absolute temperature (T). **(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) Consider two parallel co-axial circular coils of equal radius R, and number of turns N, carrying equal currents I in the same direction and separated by a distance R. Show that $B = 0.72 \frac{\mu_o NI}{R}$, where B is the field on the axis around the mid-point between the coils which is uniformly distributed over a distance that is small as compared to R and μ_o is the permeability of free space. **(06 marks)**

6. (a) Differentiate:
   (i) Ionization energy from excitation energy. **(01 mark)**
   (ii) Ionization potential from excitation potential. **(01 mark)**

   (b) (i) State Bohr's frequency condition. **(01 mark)**
   (ii) Why a very thin gold foil is used in Rutherford's α-particle scattering experiment? **(02 mark)**
   (iii) It is found experimentally that -2.2×10^{-18} J is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius and the velocity of the electron in a hydrogen atom. **(04 marks)**

   (c) What is meant by the following terms as applied in atomic and nuclear Physics?
   (i) Binding energy curve **(01 mark)**
   (ii) Nuclear mass **(01 mark)**
   (iii) Nuclear reaction **(01 mark)**
   (iv) Artificial radioactivity **(01 mark)**

   (d) In an experiment, the activity of 1.6 mg of radioactive potassium chloride (chloride of isotope K - 40) was found to be 180 s^{-1}. Taking molar mass of K - 40 Cl to be 0.075 kg mol^{-1}, find the:
   (i) number of K - 40 atoms in the sample **(02 marks)**
   (ii) half-life of K - 40. **(02 marks)**

   (e) How long can an electric lamp of 200 W be kept glowing by fusion of 3.0 kg of deuterium given that the fusion reaction taking place is ${}_{1}^{2}\mathrm{H} + {}_{1}^{2}\mathrm{H} \rightarrow {}_{2}^{3}\mathrm{He} + {}_{0}^{1}\mathrm{n} + 3.27$ MeV? **(03 marks)**