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 : 2021**

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 unauthorised 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) Pie $\pi = 3.14$
   - (c) Avogadro's Number, $N_A = 6.02\times10^{23}$ mol^{-1}
   - (d) Density of water = 10^3 kg/m^3
   - (e) Charge of an electron =1.6×10^{-19}C
   - (f) 1 year = 3.15×10^7 s
   - (g) 1 MeV = 1.6×10^{-13} J
   - (h) Permeability of free space, $\mu_0 = 4\pi\times10^{-7}$ Hm^{-1}
   - (i) Mass of an electron, $m_e = 9.1\times10^{-31}$kg
   - (j) Permittivity of free space, $\varepsilon_0 = 8.854\times10^{-12}$ Fm^{-1}
   - (k) Relative permittivity of air, $\varepsilon_r = 1$
   - (l) Surface tension of water = 0.073 N/m
   - (m) Young's modulus of steel, $E_s = 20 \times 11^{10}$ Pa

Answer **five (5)** questions.

1. (a) Give the meaning of the following terms as used in fluid dynamics:

(i) Critical velocity **(01 mark)**

(ii) Incompressible fluid **(01 mark)**

(iii) Streamline flow **(01 mark)**

(iv) Turbulent flow **(01 mark)**

(b) (i) Water flows through a pipe of internal diameter 20 cm at the speed of 1 m/s. What would be the radius of the nozzle if water is expected to emerge at the speed of 4 m/s? **(04 marks)**

(ii) Determine the coefficient of viscosity of the liquid of density 1.47×10^3 kg/m^3 if an air bubble of radius 1 cm is moving through it at the steady rate of 0.2 cm/s. **(05 marks)**

(c) (i) Write Stoke's equation as applied to motion of a body in a viscous medium and define all symbols used. **(03 marks)**

(ii) State two conditions under which Stoke's equation is valid. **(04 marks)**

2. (a) (i) What are four distinctive properties between progressive and stationary waves based on the nature and its conditions. **(04 marks)**

(ii) A 320 cm long string has two adjacent resonances at 170 Hz and 204 Hz frequencies respectively. Calculate the fundamental frequency and the speed of the wave. **(04 marks)**

(b) (i) Identify four methods used to form interference pattern apart from Young's double slit experiment. **(02 marks)**

(ii) An open and closed pipes of 40 cm and 33 cm long respectively both being of the same diameters sound their first overtone and are in unison. Determine the end correction of the pipes. **(04 marks)**

(c) In Young's double slit experiment, the distance of the screen from the two slits is 0.9 m. When light of wavelength, $\lambda = 7.5 \times 10^{-7}$ m is allowed to fall on the slits, the width of the fringes obtained on a screen is 2.5 mm. If the wavelength of the incident light is 5.5×10^{-7} m, determine;

(i) The distance between the slits. **(04 marks)**

(ii) The width of the fringes. **(02 marks)**

3. (a) (i) Use mathematical expressions to distinguish between Young's modulus of a material and Young's modulus of rigidity. **(02 marks)**

(ii) With the aid of a sketch graph, explain what happens when steel is stretched gradually by an increasing load until it breaks. **(04 marks)**

(b) (i) Determine the height at which water will rise in a capillary tube of radius 5.0×10^{-5} m if the angle of contact between water and the material of the tube is approximately zero. **(05 marks)**

(ii) A vertical steel beam of length 4.0 m and cross-sectional area of 8.0×10^{-3} m^2 supports a load of 6.0×10^{4} N. To what extent does the steel beam would be compressed along its length? **(05 marks)**

(c) If the surface tension of mercury at room temperature is 4.72×10^{-1} N/m; determine the excess pressure inside a drop of mercury of radius 0.2 cm. **(04 marks)**

4. (a) (i) State two relations which exist between field lines and electric fields. **(02 marks)**

(ii) ABC is a right angled triangle, where the right angle is at B as shown in Figure 1 and charges of -246 μC, +278 μC and +71 μC are placed at A, B and C respectively. If AB = 4 cm and BC = 3 cm, determine the electric field at the foot of the perpendicular drawn from B on the side AC. **(06 marks)**

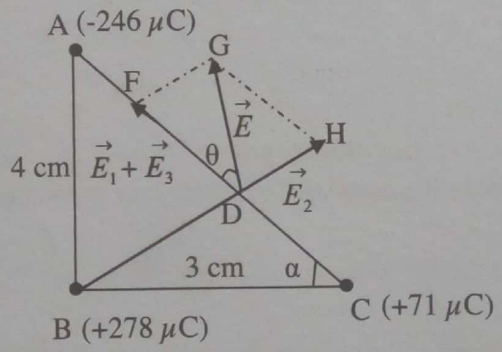

Figure 1

(b) (i) What is an electric line of force? **(02 marks)**

(ii) Carefully study Figure 2 and then calculate the work done in moving a third charge (Q_3) from B to A along the diagonal of the rectangle. **(05 marks)**

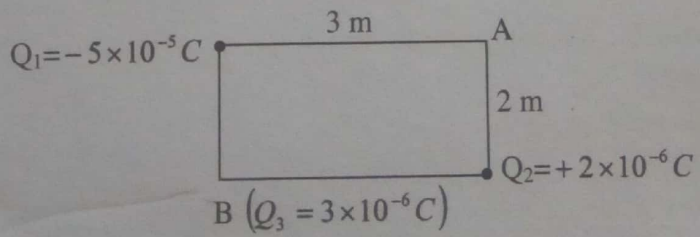

Figure 2

(c) (i) What would happen when two spheres of different capacitances are charged to different potentials and then joined by a wire? **(02 marks)**

(ii) A parallel plate capacitor has plate area of 4 m^2 spaced by three layers of different dielectric materials. If the relative permittivities and thicknesses are 3, 6, 9 and 1.0, 3.0, 0.6 mm respectively, calculate the capacitance of the capacitor. **(03 marks)**

5. (a) (i) Identify four useful applications of eddy currents. **(04 marks)**

(ii) A rectangular loop is partially held in a uniform magnetic field B which is perpendicular to the plane of the paper as shown in Figure 3. If the loop is moved towards right in the plane of the paper and perpendicular to the field with constant velocity v; derive an expression for the mechanical power P needed to move the loop in terms of the magnetic field B, the length of the plane L, the constant velocity v and the total resistance of the loop R. **(05 marks)**

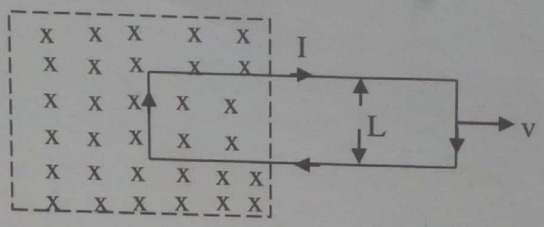

Figure 3

(b) (i) What is an electromagnetic induction? **(01 mark)**

(ii) Mention three methods of producing induced e.m.f. **(03 marks)**

(c) Why spark is produced in the switch of a fan when it is switched off? **(02 marks)**

(d) A toroid solenoid with air core has an average radius, cross-section area and number of turns of 15 cm, 18 cm^2 and 1500 respectively. If another coil of 600 turns is wound closely to the toroid, the current in the primary coil is changed from zero to 3 A in 0.06 seconds. Calculate the:

(i) self-inductance of the toroid. **(03 marks)**

(ii) induced e.m.f in the second coil. **(02 marks)**

6. (a) Briefly explain the following terms:

(i) Activity **(01 mark)**

(ii) Chain reaction **(01 mark)**

(iii) Half-life **(01 mark)**

(iv) Critical mass **(01 mark)**

(b) How many disintegrations per second occur in 1 g of uranium $\left({}_{92}U^{238}\right)$ of half life 4.5×10^9 years when under goes alpha (α) decay? **(06 marks)**

(c) Given that the mass of deuterium nucleus, neutron and one isotope of helium are 2.015 u, 3.017 u and 1.009 u respectively;

(i) Calculate the energy released by the fusion of 1 kg of deuterium. **(06 marks)**

(ii) How many days would the station be able to function if 50% of the energy obtained in (c) (i) was continuously used to produce 1 MW of electricity? **(04 marks)**