THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE, REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

FORM SIX SPECIAL SCHOOLS JOINT EXAMINATION

CODE: 131/2 **PHYSICS 2**

Time: 3:00 HRS Friday 2**1-February-2025 AM**

INSTRUCTIONS

i. This paper consists of six (6) questions.

ii. Answer five (5) questions

iii. Each question carries twenty (20) marks.

iv. Mathematical table and non- programmable calculators may be used.

v. Any an authorized material is not allowed in the examination room

vi. Write your examination number in each page of your answer sheet(s) or booklet(s)

vii. The following information may be useful:

a) Surface tension of mercury = 0.472N/m
b) Young modulus of steel ES= 2×1011NM-2
c) Young modulus of copper Ec= 1.3 ×1011NM-2
d) Work function of potassium (wo) =3.52 ×10-19J
e) Permeability of free space H=4 π × 10-7HM-1
f) Change of election e= 1.6 ×10-19C
g) Planks constant h = 6.63 × 10-34JS
h) Permittivity of free space Ɛ0 = 8.85 ×10-12 FM-1
i) Mass of election Me= 9.1V10-31 kg
j) Acceleration due to gravity g = 9.8 m/s
k) Density of water ρw = 1000Kg/m3
l) Pie π = 3.14
m) Speed of electromagnetic wave c = 3×108m/s
n) Surface tension of water γw = 0.072N/M

o) Absolute temperature T = 273k
p) Atmospheric pressure Pa =1.013 ×105 Pa

1. (a) (i) Write down the Bernoulli's equation for the fluid flow in a pipe. Indicate the disappearing term when the fluid flow is stopped. **(3 marks)**

   (ii) Water flows into a tank of large cross-sectional area at a rate of 2×10^{-4} m^3/s, but flows out from a hole of area 2 cm^2 which has been punched through the base so that students can get some water for drinking, How high does the water rise in the tank? **(4 marks)**

   (b) (i) Write down the formula for 'viscous drag force' on a sphere falling in a fluid as stated by Stokes. All symbols should carry their usual meaning. **(3 marks)**

   (ii) When a Child drops a metal sphere in a liquid and sphere starts to move from rest, what are the magnitude, the direction of the forces acting on it and the relationship between the forces acting on it? **(3 marks)**

   (c) (i) Under a given pressure head the rate of liquid through a pipe is Q. If the length of pipe is doubled and the diameter is halved, what will be the rate of flow? **(3 marks)**
   (ii) How will you compare the viscosity of the two liquids? **(4 marks)**

2. (a) In a closed pipe of length 1.7 m, vibrations are set up with four nodes. If the speed of the wave through the air medium is 340 m/s. Calculate:
   (i) the mode of vibration of the closed pipe. **(01mark).**
   (ii) its fundamental wavelength of vibration. **(01mark).**
   (iii) its fundamental frequency of vibration. **(01mark).**
   (iv) its wavelength when vibrating with four nodes. **(01mark).**
   (v) its frequency of vibration with four nodes. **(01mark).**
   (vi) its first overtone frequency. **(01mark).**
   (b) What is Doppler effect? State five applications of Doppler effect. **(04marks).**
   (c) Two cars situated 1 km apart sound their horns of frequency 330 Hz. A man is moving away from one car towards the other with a speed of 2 m/s. What will be the beat frequency heard by the man. **(04marks).**
   (d) Explain why Water waves produced by a motor boat sailing in water is both longitudinal and transverse waves. **(04marks).**
   (e) Explain why solids can support both longitudinal and transverse waves, but only longitudinal waves can propagate in gases. **(02marks).**

3. What is the posssible explanation of the following phenomenon:

(i) The angle of contact of mercury with glass is obtuse, while that of water with glass is acute. **(02marks).**

(ii) Water on a clean glass surface tends to spread out while mercury on the same surface tends to form drops**.** **(02marks).**

(iii) Surface tension of a liquid is independent of the area of the surface. **(02marks).**

(iv) Water with detergent dissolved in it should have small angles of contact. **(02marks).**

(v) A drop of liquid under no external forces is always spherical in shape. **(02marks).**

b. Two mercury droplets of radii 0.1 cm and 0.2 cm collapse into one single drop. What amount of energy is released in this process? **(05marks).**

c. The length of a metal wire is recorded to be l_1 under a tension T_1 and l_2 under a tension T_2. What is natural length of the wire. **(05marks).**

4. (a) (i) State two limitations of coulombs law of electrostatics. **(02 marks)**

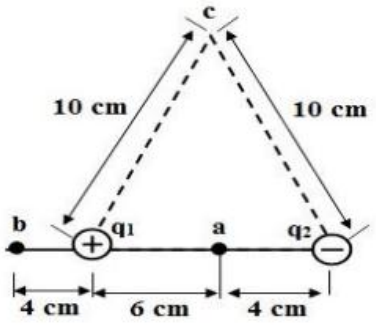
(ii) Two tiny conducting balls of identical mass m and identical charge q hang from non-conducting threads of length L. Assume that θ is so small that tan θ can be replaced by sin θ; show that, for equilibrium where 2θ is the angle between the two ropes

$$X = \left(\frac{q^2 L}{2\pi\varepsilon_0 mg}\right)^{1/3}$$

: (05 marks)

(b) (i) Distinguish electric potential from electric potential energy. (02 mark)

(ii) Point charges q1=+12x10^{-9} C and q2= -12x10^{-9} C are placed 10 cm apart, as shown in the figure below. Calculate the potential energy of a point charge q3=+4x10^{-9} C if it is placed at the points a, b and c. **(05 marks)**



(c) A 20 µF capacitor is charged to a potential difference of 1000 V. The terminals of the charged capacitor are then connected to those of an un-charged 5 µF capacitor. Compute: -

(i) The original charge of the system.

(ii) The final potential difference and charges across each capacitor.

(iii) The final energy of the system, and

(iv) The decrease of energy when the capacitors are connected. (06 marks)

5. (a) Briefly explain each of the following

(i) Why does the picture of TV screen become distorted when a magnet is brought near the screen? (02 marks)

(ii) A body is suspended from the lower end of a vertical spring. If a direct current is passed through the spring, what will happen? Why? (02 marks)

(iii) When a paramagnetic substance is placed in an external magnetic field the dipoles are partially aligned in the direction of the applied field. Why? (02 marks)

(b) A horizontal wire of length 15 cm carries a current of 5A. Find the magnitude and direction of the magnetic field which can support the weight of the wire. Assume wire to be of mass per unit length 3×10^{-3} kg/m (04 marks)

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(c) A solenoid of length 0.4 m and having 500 turns of wire carries a current of 3A . If a thin coil of 10 turns of wire and of 0.02 radius carries a current of 0.4A placed within a solenoid, calculate the torque required to hold the coil in. the middle of the solenoid with its axis perpendicular to the axis of the solenoid. (05 marks)

(d) A metal wheel with 8 metallic spokes each 60cm long is rotated at speed of 100 revolution per minutes in a plane perpendicular to the earth magnetic field of 0.3×10^{-4} T . Find the magnitude of the induced e.m.f between the axle and the rim of the wheel. (05 marks)

6. (a) (i) Define the term Activity and half-life. (02 marks)

(ii) The half life of $_{92}U^{235}$ against alpha decay is 4.5×10^{9} years. How much disintegration per second occur in 1g of $_{92}U^{235}$ (04 marks)

(b) Explain the meaning of the following terms;

(i) Nuclear fusion (02 marks)

(ii) Nuclear fission (02 marks)

(iii) Chain reaction (02 marks)
(iv) Critical mass (02 marks)

(c) (i) Uranium-234 is radioactive and emits α - particles at what appears to be at constant rate. A sample of uranium -234of mass is 2.65 $x10^{-6}$g found to have an activity of 604 Bq Calculate, its half-life in years. (04 marks)

(ii) Suggest why the activity of uranium-234 appears to be constant. (03 marks)