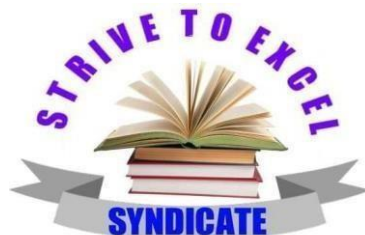


**THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE, REGIONAL ADMINISTRATION AND
LOCAL GOVERNMENT**



FORM SIX SPECIAL SCHOOLS JOINT EXAMINATION

CODE: 131/2

PHYSICS 2

Time: 3:00 HRS

Friday 21-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 = 0.472 N/m
 - b) Young modulus of steel $ES = 2 \times 10^{11} \text{ NM}^{-2}$
 - c) Young modulus of copper $Ec = 1.3 \times 10^{11} \text{ NM}^{-2}$
 - d) Work function of potassium (w_0) = $3.52 \times 10^{-19} \text{ J}$
 - e) Permeability of free space $H = 4 \pi \times 10^{-7} \text{ HM}^{-1}$
 - f) Charge of election $e = 1.6 \times 10^{-19} \text{ C}$
 - g) Planks constant $h = 6.63 \times 10^{-34} \text{ JS}$
 - h) Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12} \text{ FM}^{-1}$
 - i) Mass of election $Me = 9.1 \times 10^{-31} \text{ kg}$
 - j) Acceleration due to gravity $g = 9.8 \text{ m/s}^2$
 - k) Density of water $\rho_w = 1000 \text{ Kg/m}^3$
 - l) Pie $\pi = 3.14$
 - m) Speed of electromagnetic wave $c = 3 \times 10^8 \text{ m/s}$
 - n) Surface tension of water $\gamma_w = 0.072 \text{ N/M}$

wazaelimu.com

- o) Absolute temperature $T = 273\text{k}$
- p) Atmospheric pressure $P_a = 1.013 \times 10^5 \text{ Pa}$

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 $2 \times 10^{-4} \text{ m}^3/\text{s}$, 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 possible 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)**

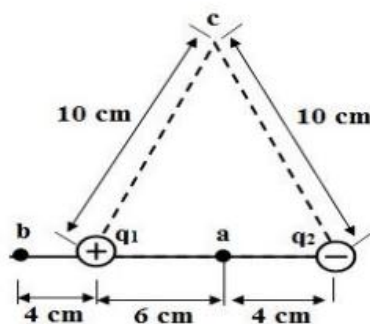
(ii) Two tiny conducting balls of identical mass m and identical charge q hang from non-conducting threads of length L . Assume that θ is so small that $\tan \theta$ can be replaced by $\sin \theta$; show that, for equilibrium where 2θ is the angle between the two ropes

$$X = \left(\frac{q^2 L}{2\pi\epsilon_0 mg} \right)^{1/3} \quad :$$

(05 marks)

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

(ii) Point charges $q_1 = +12 \times 10^{-9} \text{ C}$ and $q_2 = -12 \times 10^{-9} \text{ C}$ are placed 10 cm apart, as shown in the figure below. Calculate the potential energy of a point charge $q_3 = +4 \times 10^{-9} \text{ C}$ if it is placed at the points a, b and c. **(05 marks)**



(c) A $20\ \mu\text{F}$ capacitor is charged to a potential difference of $1000\ \text{V}$. The terminals of the charged capacitor are then connected to those of an un-charged $5\ \mu\text{F}$ 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 $15\ \text{cm}$ carries a current of $5\ \text{A}$. 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 $3 \times 10^{-3}\ \text{kg/m}$ (04 marks)

(c) A solenoid of length $0.4\ \text{m}$ and having 500 turns of wire carries a current of $3\ \text{A}$. If a thin coil of 10 turns of wire and of 0.02 radius carries a current of $0.4\ \text{A}$ 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 $60\ \text{cm}$ long is rotated at speed of 100 revolution per minutes in a plane perpendicular to the earth magnetic field of $0.3 \times 10^{-4}\ \text{T}$. 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 ${}_{92}\text{U}^{235}$ against alpha decay is 4.5×10^9 years. How much disintegration per second occur in $1\ \text{g}$ of ${}_{92}\text{U}^{235}$ (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 -234 of mass is 2.65×10^{-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)