THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE,REGIONAL ADIMINISTRATION AND LOCAL GOVERMENT

FORM SIX SPECIAL JOINTS EXAMINATION

131/2 **PHYSICS 2**

Time:3:00 HRS Monday **24-Feb-2020 AM**

INSTRUCTIONS;

1. This paper consists of only six questions ANSWER only five questions.
2. Marks for each question or part thereof are indicated.
3. Mathematical table and non programmable calculators may be used.
4. Cellular phones are not allowed in the examination room.
5. Write your examination number on every page of your answer sheet(s)/booklet(s)
6. The following information may be useful**.**
   i. Acceleration due to gravity g = 9.8m/s
   ii. Pie $\pi = 3.14$
   iii. Density of mercury = $13.6 \times 10^3 kg/m^3$
   iv. Density of water = $10^3 kg/m^3$
   v. Charge of an electron, e = $1.6 \times 10^{-19} C$
   vi. Speed of light, c = $3.0 \times 10^8 m/s$
   vii. Plank's constant, h = $6.63 \times 10^{-34} Js$.
   viii. 1u = 931MeV.
   ix. Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$.
   x. Rydberg constant, R = $1.097 \times 10^7 m^{-1}$
   xi. Young's modulus of copper, Y= $1.1 \times 10^{11} Nm^{-2}$
   xii. Young's modulus of steel = $2 \times 10^{11} Nm^{-2}$
   xiii. Mass of an electron, $m_e = 9.1 \times 10^{-31} kg$
   xiv. Permittivity of free space, $\varepsilon_0 = 8.85 \times 10^{-12} Fm^{-1}$
   xv. Velocity of sound in air =344m/s.

ANSWER ANY FIVE QUESTIONS (100 Marks)

1 (a) Distinguish between Streamline and Turbulent flow in liquids **(03marks)**

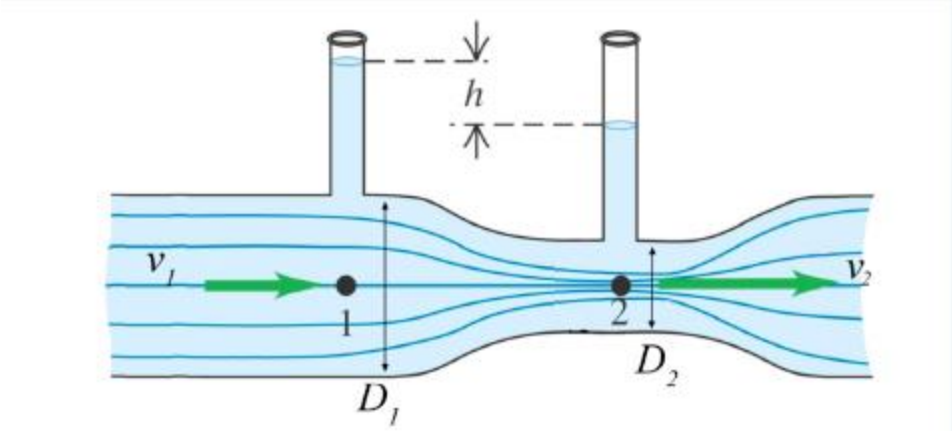
(b) Give plausible explanation of the followings:

i. The speed of innermost layer of a whirlwind is alarmingly high **(03marks).**

ii. A flag flutter, when strong winds are blowing on a certain day **(02marks).**

iii. The accumulation of snow on an aero plane wings may reduce the lift **(02marks).**

(c) A Venturi meter used to measure flow rate in pipes is installed in a horizontal water pipe as shown in the diagram below. The pipe has circular cross section with diameter D_1 in the first segment and D_2 in the second segment with D_2<D_1.The density of water is ρ.The volume flow rate in the pipe is R measured in m^3/s.



i. Obtain an expression of the speed of flow V_1 in the first section of the pipe in terms of R and D_1 **(02marks).**

ii. What is the speed of flow V_2 in the second section of the pipe? **(01mark).**

iii. Find an expression for pressure difference between point 1 and point 2. **(02marks).**

iv. What is the difference h in water level in two tubes expressed in terms of R,D_1 and D_2 ***(03marks).***

v. If the volume flow rate through the pipe is $10^{-3}m^3$/s and the pipe has a diameter 0.1m at point 1.Given the density of water 1000Kg/m^3 and viscosity of water is 10^{-3}Ns/m^2.Determine the type of flow in the pipe **(02marks).**

2. (a) (i) In an experiment it was found that the string vibrate in three loops when 8g were placed on the scale pan .What mass must be placed on the pan to make the string vibrate in six loops(Neglect the mass of the string and the scale pan) (**2 marks**)

(ii) Two sitar strings A and B playing the note "dha" are slightly put of tune and produces beats of frequency 5Hz.The tension of the string B is slightly increased and the beat frequency is found to reduce to 3Hz.What is the original frequency of B if the frequency of A is 427 Hz (**3 marks**)

(b)(i) What are sound waves? (**2 marks**)

(ii)A small explosion is set off on a steel railway line and the observer1 kilometer away with one ear to the rail hears two reports. Find the interval between the two reports if air pressure is 10^5Pa. (**3marks**)

(c) (i) Define the terms "node" and "antinode" as applied to stationary waves (**3marks**)

(ii) A sonometer wire of length 76cm is maintained under a tension of 40N while an alternating current is allowed to pass through it. A horse shoe magnet is now placed with its poles above and below the wire at its mid-point and the resulting force setting the wire in resonant vibration. If the density of wire is 8800kg/m^3 and its diameter is 1mm, what is the frequency of alternating current? (**4 marks**)

(d) Two trains moving along parallel tracks in opposite directions whistled each other at a frequency of 400Hz. If one train travels at a 25m/s what must be the speed of the other train so that a stationary observer at their point of convergence hears 5 beats per second. **(3 Marks)**

3. (a) Explain the following:
   - **i.** Rain drops hit the ground with less force than they should **(02marks).**
   - ii. Oil is poured to calm sea waves **(02marks).**
   - iii. The new earthen pots keep water cooler than the old ones **(02marks).**

(b)A soap bubble in a piston chamber of pressure has a radius R. If the piston is pulled out until the radius of a soap bubble doubles.

i. Show that the new pressure inside the chamber is given by P=$\frac{P_0}{8}$ -$\frac{3\gamma}{2R}$ where γ is the surface tension of soap solution **(04marks).**

ii. If the piston is compressed until the radius is halved, show that the new pressure inside the chamber is P=8P_0 +$\frac{24\gamma}{R}$ **(04marks).**

(c) A 2.0m light rigid rod is suspended from the ceiling by two vertical wires A and B each having a natural length of 1.0m attached to each end of the rod .A is a copper wire with Young's modulus 1.24x10^{11}N/m^2 and diameter 1.60mm and B is a brass wire of Young's modulus 9x10^{10} N/m^2 and diameter 1.0mm.A 80Kg mass is attached to the midpoint of the rod. Calculate:

i. The tension in each wire assuming the rod is rod is horizontal (**02marks).**

ii. The consequent extension of A **(02marks**).

iii. The angle the rod makes with the horizontal **(02marks).**

4. (a) (i) The electrostatic force between two protons situated at a distance x from each other is y Newton. What will be the electrostatic force between two electron situated at the same distance. **(02marks)**

(ii) A charged particle is fired with a velocity v making a certain angle with an electric line of force .Will the charged particle move along the line of force.

(0**1mark)**

(b) (i) A boy brings the palm of his hand near the disc of a charged gold leaf electroscope. The leaves of the electroscope are observed to collapse slightly. But when the boy moves his hands away from the gold leaf electroscope, the leaves resume their original position .How do you explain the behavior of the leaf. (**2.5 marks**)

(ii)Two charges of 10^{-9}C each are 8cm apart in air. Calculate the magnitude and direction of forces exerted by these charges on a third charge of 5 x 10^{-9}C which is 5cm from each of the first two charges. Calculate also the resultant force for all charges.

(0**4 marks**)

(c) (i) Explain why capacitors are important. (0**2 marks**)

(ii) Two spherical conducting shells of radii 5 and 10cm are maintained at 300V and 600V respectively. The two shells are joined together by a wire. Calculate the energy lost assuming that the two shells are 50mm apart. (**2.5marks)**

(iii) Two large horizontal metal plates are 2cm apart in vacuum. The upper Plate is maintained at a positive potential relative to the lower plate so that the field strength between them is $2.5x10^{5}Vm^{-1}$. Calculate the potential difference between the plates and the speed on reaching the upper plate of an electron liberated from rest at the lower plate **(03 marks**)

(d) Two capacitors of capacitance 15μF and 20μF are connected in series to a 600V d.c. supply.

i. Charge on each capacitor **(01 Mark**)

ii. P.d across each capacitor. **(02Marks)**

5. (a). Write down the statement of ampere's circuit law and write the corresponding equation **(02marks).**

(b) Using diagram describe in what way is the behaviour of diamagnetic material different from that of paramagnetic material when kept in an external magnetic field **(03 marks).**

(c) Explain by giving reasons for the following:

i. Increasing the current sensitivity of galvanometer may not necessarily increase its voltage sensitivity **(01$\frac{1}{2}$marks).**

ii. A galvanometer cannot be used to measure current in a given circuit **(01$\frac{1}{2}$marks).**

iii. No force is experienced by a stationary charge in a magnetic field **(01$\frac{1}{2}$marks).**

iv. No two magnetic lines of force intersect each other **(01$\frac{1}{2}$marks).**

(d) The current flowing through an inductor of self inductance L is continously increasing .Plot a graph showing the variation of :

i. magnetic flux versus current **(02marks)**

ii. Induced emf versus $\frac{dI}{dt}$ **(02marks)**

iii. magnetic potential energy stored versus the current **(02marks).**

(e) Starting from expression for energy U=$\frac{1}{2}LI^2$ stored in solenoid of self inductance L to build up a current I,obtain the expression for magnetic energy in terms of magnetic field B,area A and length l of solenoid having n number of turns per unit length **(03marks)**.

6. (a)Write the relation for Binding energy in MeV of a nucleus of mass ${}^{A}_{Z}M$,atomic number (Z) and mass number (A) in terms of masses of its constituents-Neutrons and protons (**02marks)**.

(b) Draw a Plot of BE/A versus mass number A for $2 \leq A \leq 170$.Use this graph to explain the release of energy in the process of nuclear fusion of two light nuclei

(04marks).

(c) A star initially has 10^{40} deutrons.It produces energy via the processes:

${}^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{1}H + {}^{1}_{1}P$ and
${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$,
where the masses of the nuclei are ${}^{2}_{1}H$=2.014amu, ${}^{1}_{1}P$=1.007amu, ${}^{1}_{0}n$=1.008amu and ${}^{4}_{2}He$=4.001amu.If the average power radiated by a star is 10^{16}W. How long will deuteron supply of the star is exhausted **(07marks).**

(d) Read the following passage and answer the following questions:

A nucleus at rest undergoes a decay emitting an α-particle of de Broglie wavelength 5.76×10^{-15}m.The mass of daughter nucleus D is 223.610amu and the mass of an α-particle is 4.002amu.Take 1amu=1.656×10^{-27}Kg and Planck's constant h=6.63×10^{-34}Js.

i. What is the momentum of the α-particle in Kgm/s **(01mark).**
ii. Calculate the total Kinetic Energy of two particles **(03marks).**
iii. Calculate the mass of the parent nucleus **(03marks).**