UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF BIOMEDICAL SCIENCE AND TECHNOLOGY (BMED)

PHYS 120: GENERAL PHYSICS

STREAM: R   *TIME: 2 HRS*

DAY: WEDNESDAY[8.30A.M – 10.30A.M]   *DATE: 10/04/2024*

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

Vision : A University for Valued Transformation of Society   **Page 1 of 5**
Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

Laikipia University is ISO 9001:2015 and ISO/IEC 27001:2013 Certified

INSTRUCTIONS TO CANDIDATES:

Answer question **ONE** and any **TWO** questions

Question one carries **40 marks** while all other carry **15 marks:**

You may use the following constants

$\varepsilon_o = 8.85 \times 10^{-12}$ F/M

$k = 9.0 \times 10^9 NC^2 m^{-2}$

$g = 10 m/s^2$

SHC of water = 4200J/kgk

SHC of ice = 2100J/kgk

SHC of Steam = 1800J/kgk

Specific latent heat of fusion of ice = 3.6×10^5 J/kg

Specific latent heat of vaporization of water = 3.0×10^5 J/kg

QUESTION ONE (40 MARKS)

(a) Differentiate between the following terms giving example of each.

   (i) Scalars and vectors

   (ii) Derived and basic quantities   **(4 Marks)**

(b) (i) State two applications to which dimensional analysis can be put and one
        limitation associated with one of the applications.   **(3 Marks)**

   (ii)   Check if an equation of centripetal force given as $F = \frac{Mv^2}{r}$ is correct where F is force ,m is

          mass is linear velocity and r is radius of the circle.   **(2 Marks)**

   (iii) Convert 3g/cm^3 into kg/m^3 **(2 Marks)**

(c) (i) A car accelerates at 75km/hr^2.Compute the acceleration in m/s^2 .   **(2 Marks)**

Vision : A University for Valued Transformation of Society   *Page 2 of 5*
Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

Laikipia University is ISO 9001:2015 and ISO/IEC 27001:2013 Certified

(ii) A jet in taking off from the deck of an air craft carrier. Starting from rest, the jet is catapulted with a constant acceleration of 31 m/s^2 along a straight line and reaches a velocity of 62 m/s. Find the displacement of the jet.   **(2 Marks)**

(iii) A stone is dropped from the top of a tower 50 m tall and another stone is projected vertically upwards at 40 m/s at the same time. Determine the time taken for the two stones to meet.

(3 Marks)

(d) (i) State Newton's second law of motion and give its equation form.   **(2 Marks)**

(ii) A 2kg mass falls 400cm.How much work was done on it by the gravitational force.

(2 Marks)

(iii) Calculate the recoil velocity of a gun having mass equal to 5 kg, if a bullet of 25 g acquires the velocity of 500 ms^{-1} after firing from the gun   **(3 Marks)**

(e) (i) State the differences between heat capacity and specific heat capacity.   **(2 Marks)**

(ii) State any two modes of heat transfer.   **(2 Marks)**

(iii) Calculate the quantity of heat required to raise the temperature of a block of mass 2kg from 20°C to 60°C.(Given the SHC of the block=400J/KgK).   **(2 Marks)**

(f) Two charges of 4.0μc and 9.0μc are 30 cm apart. Calculate the force between these two charges in the vacuum.   **(2 Marks)**

(g) Two resistors of resistance 8Ω and 12Ω in parallel are connected to the terminal of a battery consisting of four dry cells each having an E.M.F of 1.5V in series. If the current which passes 8Ω resistance is 0.72A, calculate

(i) The current in the 12 Ω resistor   **(2 Marks)**

(ii) The internal resistance of the battery   **(2 Marks)**

(h) Uranium-238 undergoes decay to Radium-226 by emitting alpha particles and beta particles. $^{238}_{92}U \longrightarrow\ ^{226}_{88}Ra\ + x\beta + y\alpha$. Determine the value of x and y **(3 Marks)**

Vision : A University for Valued Transformation of Society   *Page 3 of 5*
Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

Laikipia University is ISO 9001:2015 and ISO/IEC 27001:2013 Certified

QUESTION TWO (15 MARKS)

(a) The rate of energy spend by a dragonfly when it is hovering above a pond depends on the density ρ of the air, the length of the wings l and the upward force on its wings F. If the power it would have to spend hovering above the pond in given by P. Use the method of dimensions to determine how P is related to ρ, l and F. **(5 Marks)**

(b) Consider a body that starts with an initial velocity u and has a constant acceleration a. If it covers a certain distance (displacement) s in time t and its velocity is v, derive the three equations of motion. **(5 Marks)**

(c) A speed boat has a constant acceleration of 2 m/s^{2}. If the initial velocity of the boat in 6.0 m/s, find its displacement after 8.0 sec. **(2 Marks)**

(d) A minibus of mass 2000 kg travelling at a constant velocity of 36 km/h collides with a stationary car of mass 1000 kg. The two moves together at a common velocity. Calculate the common velocity. **(3 Marks)**

QUESTION THREE (15 MARKS)

(a) (i) Distinguish between Heat and temperature. **(2 Marks)**

(ii) A calorimeter cup made from 0.15kg of aluminums and contains 0.20 kg of water. Initially the water and the cup have a common temperature of 18.0^{0}C. An unknown material (m=0.040kg) is heated to a temperature of 97.0^{0}c and then added to the water. The temperature of the water, cup and the unknown material is 22.0^{0}C after the thermal equilibrium is re-established. Ignoring the small amount of heat gained by the thermometer, find the specific heat capacity of the unknown material. (Take the SHC of aluminum and water as 900 J/KgK and 4200 J/KgK respectively)

(4 Marks)

(b) Determine the total heat required to change 80kg of ice at -42^{0}C to steam at 150^{0}C . **(4 Marks)**

(c) A manufacturer designs an immersion heater which has a power output of 120W. The heater is used to raise temperature of 2kg of liquid from 15°C to 35°C in 10 minutes. Assuming that 25% of the energy supplied by the heater is lost from the liquid to the surrounding. Calculate

(i) Energy supplied to heater in 10 minutes **(2 Marks)**

(ii) Specific heat capacity of the liquid **(3 Marks)**

Vision : A University for Valued Transformation of Society   *Page 4 of 5*
Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

Laikipia University is ISO 9001:2015 and ISO/IEC 27001:2013 Certified

QUESTION FOUR (15 MARKS)

(a) (i) In a single statement state what is meant by electrostatics.   **(2 Marks)**

   (ii) State Coulombs law of electrostatics.   **(2 Marks)**

   (iii) Sketch the electric field lines and equipotential lines associated with an isolated

        negative charge   **(2 Marks)**

   (iv) A charge of 4.5 µC is located 0.5 m from a charge of -3.8 µC. Find the

        Electrostatic force exerted by the charges or each other   **(2 Marks)**

(b) (i) State Ohm's law   **(2 Marks)**

   (ii) The starter motor in a car draws a current of 8 A during a short time the car is being started. The car operates on a 12 V electrical system battery. What is the electrical resistance of the current from the battery through the starter motor?   (**2 Marks)**

   (iii) Determine the value of resistance that must be placed in parallel with 24k Ω to

        yield an equivalent resistance of 1.5 k Ω   **(3 Marks)**

QUESTION FIVE (15 MARKS)

(a) (i) Define Half life .   **(2 Marks)**

   (ii) State one uses of radioactivity in medicine and one uses in industry.   **(2 Marks)**

(b) A radioactive element X of half life of 28 days decays to elements Y.A Sample of X of mass 16g is kept in a container. Assuming Y is stable; calculate the mass of Y that will be in the container after 112days.   (**3 Marks)**

(c) (i) How are X-rays produced.   **(2 Marks)**

   (ii) State one use of X-rays in medicine and one use in industry.   **(2 Marks)**

   (iii) Give two dangers of X-rays   **(2 Marks)**

   (iv) State two precautions to be observed when dealing with X-rays   **(2 Marks)**

Vision : A University for Valued Transformation of Society   *Page 5 of 5*
Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

Laikipia University is ISO 9001:2015 and ISO/IEC 27001:2013 Certified