LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREES OF BACHELOR OF EDUCATION (SCIENCE) AND BACHELOR OF SCIENCE (GENERAL)

PHYS 120: GENERAL PHYSICS

STREAMS: R ***TIME: 2 HRS***

DAY: FRIDAY [11.30 – 1.30 P.M] ***DATE: 30/01/2026***

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS:

Answer question one Compulsory (40 MARKS) and any other two questions (15 MARKS each).

QUESTION ONE (40 MARKS)

(a). Define the terms;

i) Ideal Gas
ii) Chromatic Aberration
iii) Electric charge
iv) Electrostatics
v) Conductivity **(5 Marks)**

(b) Explain three applications of X-rays in Medicine **(3 Marks)**

(c) A test charge of 6.0×10^{-18} C is placed at a point in an electrostatic force of 3.02×10^{-18}N.What is the magnitude of the electric field at that point? **(2 Marks)**

(d) Define the term capacitance and state two factors affecting it. **(2 Marks)**

(e) Two capacitors $C_1 = 6\mu F$ and $C_2 = 10\mu F$ are connected in series. Calculate the resultant capacitance **(3 Marks)**

(f) A block of metal initially at 90^0C is to be heated, its cross sectional area is $120m^2$ while its thickness is 18cm.Given that the source of heat is at 500^0C, Calculate the amount of energy gained every second.(Take the conductivity of the metal as 0.35cal/cm.^{0}C.s) **(3 Marks)**

(g) What causes rainbows in the sky? Why do we rarely see rainbows at noon? **(2 Marks)**
(h) State three properties of an ideal gas. **(3 Marks)**

(i) The length of a certain block of metal (iron), is 25m and cross sectional area $20cm^2$.The metal is heated so that its temperature changes from 10^oC to 45^oC.Calculate;

i) The change in length **(2 Marks)**

ii) Change in area. **(2 Marks)**

iii) Change in volume. (Take α for iron as $12 \times (10^{-6}K^{-1})$) **(2 Marks)**

(j) Distinguish the following terms as used in heat and thermodynamics

(i). Latent heat of vaporization and latent heat of fusion **(2 Marks)**

(ii). Condensation and boiling **(2 Marks)**

(iii). Freezing and melting **(2 Marks)**

(k) An electron with K.E =10^7ev moves perpendicular to the lines of a uniform field B=10^{-2} T. Determine;

(i). The period and frequency of its orbit **(2 Marks)**

(ii). The radius of orbit **(3 Marks)**

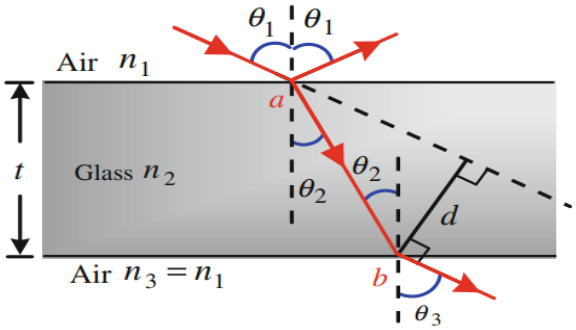
QUESTION TWO (15 MARKS)

(a) A beam of monochromatic light traveling through air strikes a slab of glass at an angle $\theta_1 = 60^\circ$ to the normal, see Fig. below. The glass has a thickness t = 1 cm and refractive index n = 1.52.

(i) Find the angle of refraction θ_2. **(2 Marks)**

(ii) Show that the emerging beam is parallel to the incident beam. **(3 Marks)**

(iii) At what distance d does the beam shift from the original? **(3 Marks)**



(b) An X-ray tube which is highly evacuated is operating at 10,000V E.H.T

(i). Explain how the penetrating power of the X-rays can be increased **(1 Mark)**

(ii). Why is the tube highly evacuated? **(1 Mark)**

(iii). How can the intensity of the X-rays be reduced? **(1 Mark)**

(c) Determine for tube 2. (b). above,

(i). The energy of the cathode rays before heating the anode **(2 Marks)**

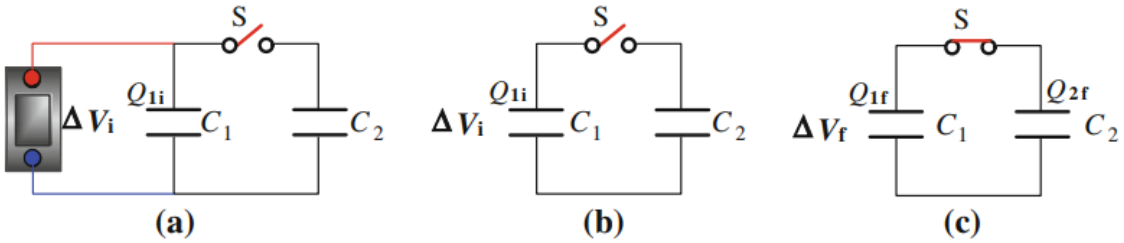
(ii). The speed of the cathode rays **(2 Marks)**

QUESTION THREE (15 MARKS)

(a) A capacitor C_1 = 4 µF is charged by an initial potential difference Vi = 12 V, see Fig. a. The charging battery is then removed, as shown in Fig. b, and the capacitor is connected to the uncharged capacitor C_2 = 2 µF, as shown in Fig. c.

(i) Find the final potential difference V_f as well as Q_{1f} and Q_{2f}. **(6 Marks)**

(ii) Find the stored energy before and after the switch is closed. **(3 Marks)**



(b) Given; $\vec{a} = 2\vec{i} - \vec{j}$ and $\vec{b} = 4\vec{i} - 3\vec{j} + 2\vec{k}$

Find: (i) $\vec{b}x\vec{a}$ **(2 Marks)**

(ii) $(\vec{a}.\vec{b}) - (\vec{a}x\vec{b})$ **(4 Marks)**

QUESTION FOUR (15 MARKS)

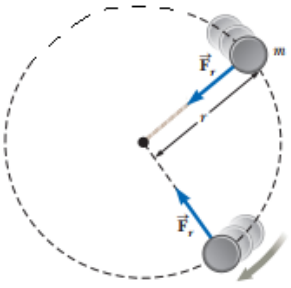
(a) Hot Aluminum block of mass 20g at 450^0C is put in an Aluminum calorimeter of mass 50g containing 2kg of water at 20^0C. Determine the equilibrium temperature attained. (Take c_w of water = 4186 $JKg^{-1}C^{-1}$, c_{Al} of aluminum = 900 $JKg^{-1}C^{-1}$ **(5 Marks)**

(b) State the first law of thermodynamics **(2 Marks)**

(c) Suppose heat is applied to the system so that it changes the state from initial state $V_iT_iP_i$ to a final state $V_fT_fP_f$. Show that the work done by the gas is given by; Average pressure x Change in volume.

$(\frac{Pi+Pf}{2}(Vf - Vi))$ **(3 Marks)**

(d) A puck of mass 6.5 kg is attached to the end of a cord 7.50 cm long. The puck moves in a horizontal circle as shown in Figure below. If the cord can withstand a maximum tension of 150N, what is the maximum speed at which the puck can move before the cord breaks? Assume the string remains horizontal during the motion. **(5 Marks)**



QUESTION FIVE (15 MARKS)

(a) A car traveling at a constant speed of 75.0 m/s passes a trooper on a motorcycle hidden behind a billboard. Three seconds after the speeding car passes the billboard, the trooper sets out from the billboard to catch the car, accelerating at a constant rate of 6.00 m/s^2. How long does it take her to overtake the car? **(3 Marks)**

(b) A sprinter runs at a speed of 12 ms^{-1} around a circular track with a centripetal acceleration of 7.8 ms^{-2}.

(i) What is the radius of the track? **(3 Marks)**

(ii) How long does it take to go completely round the track at this speed? **(3 Marks)**

(c) Heat travels through three different mechanisms, explain them **(3 Marks)**

(d) The surface temperature of a spherical metal of radius $4.5x10^5$m is 6000K.Calculate the total energy radiated by the body each second.(Assume emissivity of metal as 0.92.) **(3 Marks)**