CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 317: MATHEMATICAL PHYSICS I

STREAMS: BSC & BED SCI Y3S1 **TIME: 2 HOURS**

DAY/DATE: TUESDAY 29/08/2023 **11.30 A.M – 1.30 P.M.**

INSTRUCTIONS:

- Answer all the questions
- Use of mathematical tables and unprogrammable calculator is permissible.

Question one;

a. Differentiate between an ordinary and a partial differential equation giving an example of each (2 marks)

b. The power *P* consumed in a resistor is givenby $P=V2/R$Watts. Determine the approximatechange in power when *V* increases by5% and *R* decreases by 0.5% if the originalvalues of *V* and *R* are 50 volts and 12.5 ohmsrespectively. (4 marks)

c. A point on a curve is given by $x = 7cost + 3.5cos2t$, $y = 7sint - 3.5sin2t$. Express $\frac{d^2y}{dx^2}$ in terms of t. (4 marks)

d. Find the particular solution of the differential equation: $(x2 + y2)dy=xydx$, given that $x=1$ when $y=1$. (4 marks)

e. State the Cauchy's theorem and hence write the Cauchy integral giving two of its applications. (4 marks)

f. What are orthogonal vectors? Write the mathematical expression for two orthogonal vectors. (3 marks)

g. State the Green, Stoke and divergence theorems giving the mathematical expression for each of them. (6 marks)

h. What is meant by the gradient, divergence and curl of a vector? (3 marks)

Question two;

a.The entropy change ΔS, for an ideal gas is given by: $S = \int_{T_1}^{T_2} C_v \frac{dT}{T} - R \int_{V_1}^{V_2} \frac{dV}{V}$

where$T$ is the thermodynamic temperature,V is the volume and R=8. 314. Determinethe entropy change when a gas expands from 1 litre to 3 litres for a temperature rise from100K to 400K given that:

$C_V = 45 + 6 \times 10^{-3}T + 8 \times 10^{-6}T^2$ (6 marks)

b. The p.d. between boundaries a and$b$ of an electric field is given by: $V = \int_a^b \frac{Q}{2\pi r \varepsilon_0 \varepsilon_r} dr$

If a=10, b=20, Q=2×10^{-6} coulombs,ε_0=8.85×10^{-12} and ε_r=2.77, show that$V$ =9 kV. (4 marks)

c. d. If $\emptyset = f(r, \theta)$and $\emptyset = (Ar^n + br^{-n})sin(n\theta + \alpha)$ where A, B n and α are constants, show that $\frac{\partial^2 \emptyset}{\partial r^2} + \frac{1}{r}\frac{\partial \emptyset}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \emptyset}{\partial \theta^2} = 0$ (10 marks)

Question three;

a. The following equation represents the undamped simple harmonic motion. Obtain the general solution $\frac{d^2y}{dx^2} + 4y = 0$ (6 marks)

b. The following equation represents the damped simple harmonic motion. Obtain the general solution $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 2 = 0$ (7 marks)

c. Find the general solution for the following differential equation

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = x^2$$ (7 marks)
