NILE UNIVERSITY OF NIGERIA

HONORIS UNITED UNIVERSITIES

Faculty of Natural and Applied Sciences
Department of Physics

PHY 108
Electricity and Magnetism Lab
Experiment 6: Electrical fields and potentials in the plate capacitor

Student Name:

Student ID:

Department:

Date of Experiment:

Group:

OBJECTIVES:

a. Investigating the relationship between voltage and electric field strength with constant plate spacing
b. Investigating the relationship between electric field strength and plate spacing with constant voltage.

EQUIPMENT NEEDED:

Plate capacitor, 283×283mm	06233.02
Capacitor plate w. hole d=55mm	11500.01
Electric field meter	11500.10
Potential probe	11501.00
Power supply,0…600VDC	13672.93
High value resistor, 10MΩ	07160.00
Digital Multimeter	07134.00
Connecting cords	
Optical profile bench	08283.00
Slide mount, h=30mm	08286.01
Right angle clamp	02040.55

THEORETICAL BACKGROUND

A uniform electric field $\vec{E}$ is produced between the charged plates of a plate capacitor. In a simple parallel-plate capacitor, a voltage applied between two conductive plates creates a uniform electric field between those plates. The electric field strength in a capacitor is directly proportional to the voltage applied and inversely proportional to the distance between the plates. The strength of the field is determined with the electric field strength meter, as a function of the plate spacing d and the voltage U. the potential V within the field is measured with a potential measuring probe.

$$rot\ \vec{E} = -\vec{B}$$
$$div\ \vec{D} = \rho$$

follow from Maxwell's equations for the electric field E in the plate capacitor.

For the steady-state case in the charge-free space between the plates,

$$rot\ \vec{E} = 0 \quad (1)$$
$$div\ \vec{D} = 0 \quad (2)$$

If one plate is placed in the y-z plane and the other parallel to it at a distance d, and if boundary disturbances due to the finite extent of the plates are disregarded, it follows from (2) that E lies in the x-direction and is uniform. Since the field is irrotational (rot E = 0) it can be represented as the gradient of a scalar field φ

$$\vec{E} = -grad\emptyset = \frac{d\emptyset}{dx}$$

While E, because of its uniformity, may also be expressed as the quotient of difference

$$E = \frac{\emptyset_1 - \emptyset_o}{x_1 - x_2} = \frac{U}{d} \quad (3)$$

Where the potential difference is equal to the applied voltage
U and d is the distance between the plates.
With constant spacing d, E is thus proportional to the voltage

SETUP AND PROCEDURE

Circuit for measuring the potential between two parallel plates

TASK 1: The experimental set up is as shown in Fig. above. The electric field meter should first be zero-balanced with a voltage of 0 V. The electric field strength is now measured at various voltages at any plate spacing.

Ensuring that the plate spacing remains unchanged throughout the experiment, change the input voltage to 40V and record the corresponding electric field strength between the plates.

Repeat the procedure for 0V, 40V, 80V, 120V, 160V, 200V, and 240V and record the corresponding electric field strength between the plates respectively.

TASK 2: Now, ensure that the potential between the plates is unchanged at 250V, vary the distance between the plates to 15cm and record the electric field strength between the plates.

Repeat the procedure of **task 2** various distances of 15cm, 20cm 25cm, 30cm, 35cm, 40cm and 45cm respectively and record the corresponding electric field strength between the plates at every point of the distance.

- Plot a graph of E(KV/m) against U (v)
- Plot a graph of E(KV/m) against d (cm)
- Determine the slope of your graphs

DATA: Tabulate your readings as shown below

a) For task 1

S/N	U(V)	E (KV/m)	Log E	Log U
1				
2				
3				
4				
5				
6				
7				

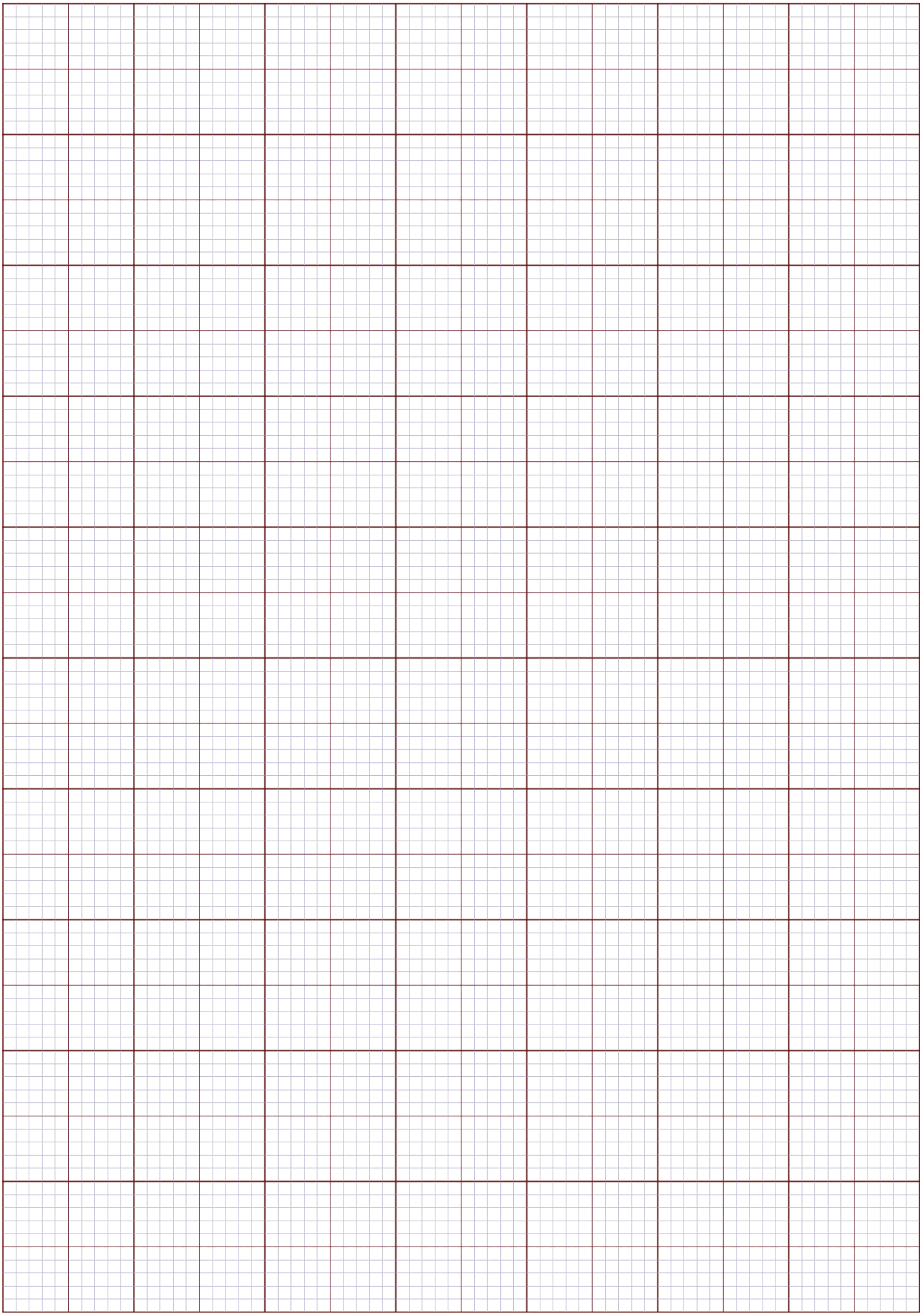
b) For task 2

S/N	d(cm)	E (KV/m)	Log E	Log d
1				
2				
3				
4				
5				
6				
7				

INSTRUCTOR SIGNATURE_____

TITLE: **SCALE:**

TITLE: **SCALE:**



DISCUSSION OF RESULTS

Discuss your result using the relation:

$$E = \frac{U}{d}$$

PRECAUTIONS

State the precautions taken to ensure accurate result

CALCULATIONS

(a) Rectangular plate has a voltage of +180V and another rectangular plate (parallel to plate to the first plate) has a voltage of -5V. Determine the field strength at any point between these two plates? The distance of separation of the plates is finite, say 8.6mm.

(b) The plates of a parallel plate capacitor, $5.0 \times 10^{-3} m$ apart are maintained at a potential difference of 5.0×10^{4}. Calculate the magnitude of the

I. Electric field intensity between the plates

II. Force on the electron