3055 BA SANGAM COLLEGE

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WORKSHEET 13

SCHOOL: BA SANGAM COLLEGE   YEAR: 13

SUBJECT: PHYSICS   NAMEOF STUDENT: _____

STRAND	4- ELECTROSTATIC
SUB-STRAND	**Capacitors with Dielectric**
LEARNING OUTCOME	• To understand about capacitors connected in circuits

Capacitors with Dielectric

- In many capacitors there is an insulating material such as waxed paper, rubber or glass between the plates. Such material, called a **dielectric**,
- Dielectric provides an increase in capacitance, reduces loss of charge and allows stronger electric field to form between the plates.
- for capacitors that have a dielectric material with a dielectric constant (k), the capacitance is given by;

$$C = \kappa \varepsilon_o \frac{A}{d}$$

Where: κ = dielectric constant

ε_o = permittivity of free space

A = Plate area

d = distance between the plates (gap)

➢ Experiments indicate that all dielectric materials have k >1

Dielectric materials with their dielectric constant.

Material	Air	Paper	Glass	Teflon	Water
κ	1	3.7	4-6	2.1	80

Example

A parallel-plate air-filled capacitor has a capacitance of 50 pF.

a) If each of its plates has an area of 0.35 m^2, what is the separation?

b) If the region between the plates is now filled with material having= 5.6, what is the capacitance

Solution

a) $\quad d = \varepsilon_o \dfrac{A}{C} = \left(8.85 \times 10^{-12}\right)\left(\dfrac{0.35}{50 \times 10^{-12}}\right) = 0.062$ m

b) $\quad C = \kappa C_i = (5.6)(50 \text{ pF}) = 280 \text{ pF}$

EXERCISE

1. The plates of a parallel plate capacitor are separated by a distance of 5.0 mm and the area of each plate is
   2 cm x 10 cm. **A dielectric material of waxed paper** is placed between the plates and the potential difference between the plates is 2000V,

    Determine:
    (i)   the capacitance

    (ii)   the charge on each plate

    (iii)   the electric field intensity between the plates

    (iv)   the energy stored in the capacitor   (6 marks)

2. A **water-filled capacitor** consists of two parallel plates, each with an area of 7.60 cm^2 and separated by a distance of 1.80 mm. If a 20.0 V potential difference is applied to these plates, calculate the:
a) Capacitance of the capacitor

b) electric field strength

c) charge between the plates.

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