Problem 26.42

a.) The dielectric constant is such that:

$$C_{with} = \kappa C_{w/o}$$

$$\Rightarrow \quad \kappa = \frac{C_w}{C_{w/o}}$$

$$\Rightarrow \quad \kappa = \frac{\cancel{Q}/V_w}{\cancel{Q}/V_{w/o}}$$

$$\Rightarrow \quad \kappa = \frac{V_{w/o}}{V_w}$$

$$= \frac{(85 \text{ V})}{(25 \text{ V})}$$
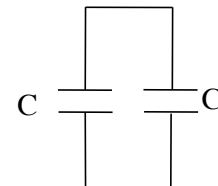
$$\Rightarrow \quad \kappa = 3.4$$

1.)

b.) What kind of material is it?

   According to Table 16.1 in the book, it is probably nylon.

c.) The dielectric weakens the E-fld between the plates. As the electric field is proportional to the electrical potential difference across the plates (the voltage of the cap), that means the voltage goes down when a dielectric is placed between the plates, and the capacitance $C = \frac{Q}{V_C}$ goes up.

   If the dielectric only partially fills the space, the electric field in the dielectric-filled region will go down as expected, with an appropriate additional voltage drop, but there will be no additional drop in the air-filled region. In other words, the net change in voltage will happen, but it will not drop as much as it would have if the space had been completely filled with the dielectric and the capacitance increase will not be as much.

2.)