3. (a)   A parallel plate capacitor with the space between the plates filled with air has a capacitance of $6\mu F$. It is charged by connecting to a 24-volt battery. With the capacitor still connected to the battery, an insulating material having dielectric constant of 2.5 is inserted into the space between the plates of the capacitor so that it fills exactly 50% of the space (see Fig. 2). Calculate the amount of charge flowing through the battery during the process (i.e., from the instant the insulating material is inserted to when it fills up 50% of the space).
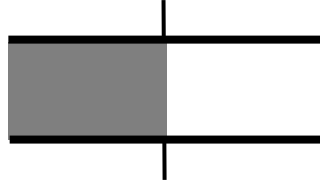

Fig. 2.

[5 marks]