Answer on Question #41238 - Physics - Electric Circuits

Question.

Two identical metal plates are given +ve charge Q1 and Q2 (Q2<Q1). If they are brought closer to form a parallel plate capacitor of capacitance C, then pot diff across C is?
a)Q1+Q2/2C
b)Q1+Q2/C
c)Q1-Q2/2C
d)Q1-Q2/C

Given: $C, Q_1, Q_2;\ Q_2 < Q_1 < 0$

Find: $\Delta\varphi$

Solution.

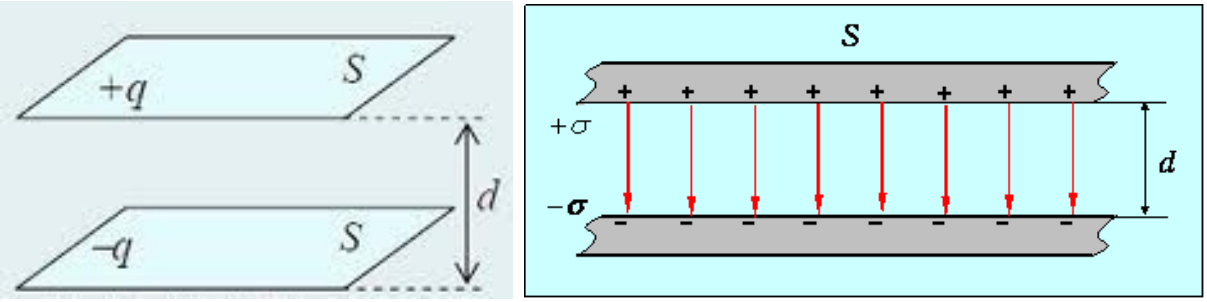

Fig.1. Plate capacitor

If the charges on the plates are $+Q$ and $-Q$, and $\Delta\varphi$ gives the potential difference between the plates, then the capacitance C is given by

$$C = \frac{Q}{\Delta\varphi}$$

So,

$$\Delta\varphi = \frac{Q}{C}$$

But in our case $Q_1, Q_2 > 0$, no negative charge like "$-Q$".

Therefore, let's imagine virtual ground (it's an analogue $Q = 0$ in classical bipolar capacitor):

$$Q_{gr} = \frac{Q_1 + Q_2}{2}$$

Then, charge of the «positive» plate relative to Q_{gr} is: $Q_+ = Q_1 = 2Q_{gr} - Q_2$

Charge of the «negative» plate relative to Q_{gr} is: $Q_- = Q_2 = 2Q_{gr} - Q_1$

Thus, following the definition of the classical capacitor from Fig.1:

$$Q = \frac{Q_+ - Q_-}{2} = \frac{(2Q_{gr} - Q_2) - (2Q_{gr} - Q_1)}{2} = \frac{Q_1 - Q_2}{2}$$

And

$$\Delta\varphi = \frac{Q}{C} = \frac{Q_1 - Q_2}{2C}$$

Answer.

c) $\Delta\varphi = \frac{Q_1 - Q_2}{2C}$