Question.

Two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of −6V. What potential should be applied to the upper plate to create electric field strength of 4000 V/m upwards in the space between the plates?

a. +22V

b. +10V

c. −10V

d. −22V

Given:

$l = 4\,mm = 4 \cdot 10^{-3}\,m$

$\varphi_1 = -6\,V$

$E = 4000\,\dfrac{V}{m}$

Find:

$\varphi_2 = ?$

Solution.

By definition the electric field is equal to:

$$E = \frac{\Delta\varphi}{l}$$

Electric field is defined by potential difference $\Delta\varphi = |\varphi_1 - \varphi_2|$. We know that electric field is directed from a higher potential to lower. In our case, electric field is directed upwards, from lower plate to upper plate. So, the potential of lower plate is bigger. That's why:

$$\varphi_1 > \varphi_2 \rightarrow \Delta\varphi = \varphi_1 - \varphi_2 \rightarrow E = \frac{\varphi_1 - \varphi_2}{l}$$

Therefore, we can find the potential of upper plate:

$$\varphi_2 = \varphi_1 - El$$

Calculate:

$$\varphi_2 = -6 - 4000 \cdot 4 \cdot 10^{-3} = -6 - 16 = -22\,V$$

So, answer is d. −22V.

Answer.

d. −22V