☹ em-que-04016

Two grounded infinite conducting planes are kept along the XZ and YZ planes, see Fig.2. A charge q is placed at (4,3) find the force acting on the charge q.

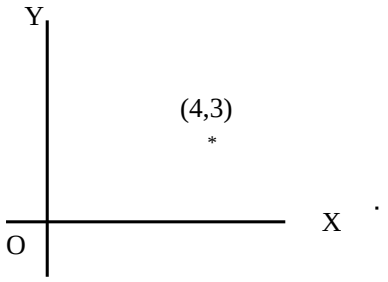

Fig. **1** Charge q is at $(4, 3)$

☺*Solution*: The given charge is located at B. There will be three image charges $-q, q, -q$ located at P, Q, R with coordinates $(-4, 3)$,$(-4, -3)$ and $(4, -3)$ respectively. See figure below.

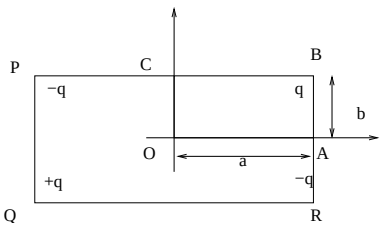

Fig. **2** Take OA=4, AB=3

The force due to the image charge at P is along the negative X-axis and

$$\vec{F}_1 = -\frac{q^2}{4\pi\epsilon_0}\frac{1}{64}\hat{i}$$

The force due to the image charge at Q is along OB and

$$\vec{F}_2 = \frac{q^2}{4\pi\epsilon_0}\frac{1}{100}\left(\frac{4}{5}\hat{i} + \frac{3}{5}\hat{j}\right) \tag{1}$$

The force due to the image charge at R is along the negative Y-axis and

$$\vec{F}_3 = -\frac{q^2}{4\pi\epsilon_0}\frac{1}{36}\hat{j}$$

Adding the three forces we get

$$\begin{aligned}
\vec{F} &= \vec{F}_1 + \vec{F}_2 + \vec{F}_3 && (2)\\
&= \frac{q^2}{4\pi\epsilon_0}\Big[\Big(-\frac{1}{64}+\frac{1}{125}\Big)\hat{i} + \Big(\frac{3}{500}-\frac{1}{36}\Big)\hat{j}\Big] && (3)\\
&= \frac{q^2}{4\pi\epsilon_0}\Big[\frac{-125+64}{64\times 125}\hat{i} + \frac{108-500}{500\times 36}\hat{j}\Big] && (4)\\
&= -\frac{q^2}{4\pi\epsilon_0}\Big[\frac{61}{8000}\hat{i} + \frac{49}{2250}\hat{j}\Big]. && (5)
\end{aligned}$$