The charges 5uC , -2uC ,3uC and -9uC are placed at the corners A,B,C and D of a square ABCD of side 1m . The electric potential at the centre of the square is A) -27 kV B) $-27\sqrt{2}$ kV C) -90 kV D) zero

Solution.

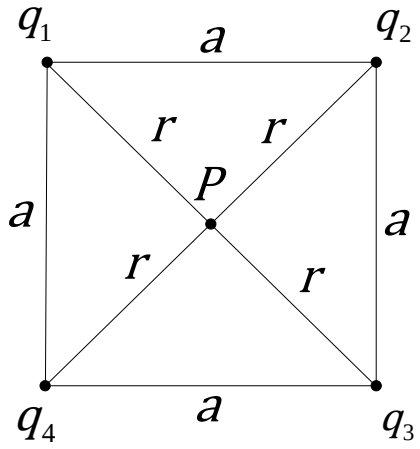

Figure 1

We denote: $q_1 = 5\,\mu\text{C}, q_2 = -2\,\mu\text{C}, q_3 = 3\,\mu\text{C}, q_4 = -9\,\mu\text{C}, a = 1\,\text{m},$ r is half the length of the diagonal of the square, P is the center of the square. According to the Pythagorarean theorem we find r:

$$2r = \sqrt{a^2 + a^2} = a\sqrt{2};\ r = \frac{a}{\sqrt{2}}.$$

Find the electric potential at the center of the square (φ_P):

$$\varphi_P = \frac{kq_1}{r} + \frac{kq_2}{r} + \frac{kq_3}{r} + \frac{kq_4}{r} = \frac{k\sqrt{2}(q_1 + q_2 + q_3 + q_4)}{a} = -27\sqrt{2}\ \text{kV},$$

where $k = 9 \cdot 10^9\ \dfrac{\text{N} \cdot \text{m}^2}{\text{C}^2}$ is Coulomb's constant.

Answer: B.