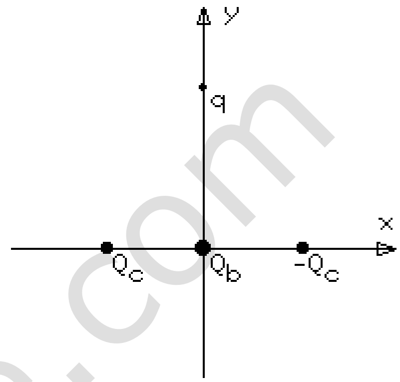
Q- Two charges Q_c and $-Q_c$ (Q_c = 4 μC) are fixed on the *x*-axis at *x* = -6 cm and *x* = 6 cm, respectively. A third charge Q_b = 5 μC is fixed at the origin. A particle with charge *q* = 0.5 μC and mass *m* = 6 g is placed on the *y*-axis at *y* = 14 cm and released. There is no gravity. Calculate the initial acceleration of the particle.



The two equal and opposite charges Qc and − Qc will make a dipole and the field on the perpendicular bisector of this dipole at a distance y is given by

$$\vec{E}_1 = \frac{1}{4\pi \in_0} \cdot \frac{2Q_C x}{\left[y^2 + x^2\right]^{3/2}} \hat{i} = \frac{(9*10^9)*2*4*10^{-6}*0.06}{\left[0.14^2 + 0.06^2\right]^{3/2}} \hat{i}$$

Or $\vec{E}_1 = 1.22*10^6 \hat{i}$ N/C

Field at the same point due to charge Q_b will be given by Coulomb's law as

$$\vec{E}_2 = \frac{Q_b}{4\pi \in_0 y^2} \left(\hat{j}\right) = \frac{\left(9*10^9\right)*5*10^{-6}}{0.14^2} \left(\hat{j}\right) = 2.296*10^6 \left(\hat{j}\right) \text{ N/C}$$

Hence force on the particle in x direction will be

$$Fx = Ex*q = E_1*q = 1.22*10^6*0.5*10^{-6} = 0.61 \text{ N}$$

And the force in y direction will be

$$Fy = Ey*q = E_2*q = 2.296*10^6*0.5*10^{-6} = 1.148 \text{ N}$$

Thus the resultant force on the particle at initial position is given by

$$F = \sqrt{F_x^2 + F_y^2} = \sqrt{0.61^2 + 1.148^2} = 1.3 \text{ N}$$

So the initial acceleration of the particle will be

$$a = \frac{F}{m} = \frac{1.3}{0.006} = 2.17 * 10^2 \ m/s$$