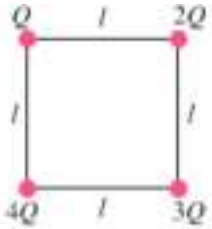
Electrostatics

Problems

How to Solve the electric force Problems

1) *First Draw Nice diagram showing all the position of the charges*
2) *Draw the forces on the point of Interest with correct direction from all the charges. It will be away for repulsion and towards for attraction*
3) *Calculate the magnitude of the all the forces using Coulumb Law where possible*
4) *Now Either we can make use of symmetry or we can choose an suitable XY Coordinate system and resolve all the force on the X and Y direction . Find out the resultant in X direction and Y direction. One thing to remember,force along the positive direction will be treated positive and force along the negative direction will be treated negative*
5) *Now you know the resultant force in X and Y direction. Now you can easily find out the total force magnitude and direction*

Question: Four charges are placed Q,2Q,3Q and 4Q are placed on the end points of the square as shown in below figure . Find the force of charge 3Q due to other charges



Solution

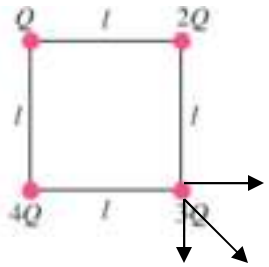
1) First step would be draw the nice diagram

2) Second step would be to show all the force on charge in Interest

Force due to charge 4Q would be in the horizontal direction

Force due to charge 2Q would be in Vertical direction

Force due to charge Q would be along the diagonal direction



Solution continued

- **Third step is to calculate the magnitude of all the forces involved**

$$F_{3q,q} = k\frac{(3Q)(Q)}{2l^2}$$

$$F_{3q,2q} = k\frac{(3Q)(2Q)}{l^2}$$

$$F_{3q,4q} = k\frac{(3Q)(4Q)}{l^2}$$

Now let us consider an XY coordinate system with origin as the lower botton corner

Now take the components of the above forces in X and Y direction , The resultant force in X and Y direction are

$$F_{3q,x} = k\frac{12Q^2}{l^2} + k\frac{3Q^2}{2l^2}\cos 45^0 = 13.067k\frac{Q^2}{l^2}$$

$$F_{3q,y} = -k\frac{6Q^2}{l^2} - \frac{3Q^2}{2l^2}\sin 45^0 = -7.067k\frac{Q^2}{l^2}$$

Solution Continued

- **Resultant Magnitude would be found using**

$$F = \sqrt{(F_{3q,x})^2 + (F_{3q,y})^2}$$

$$\tan\theta = \frac{F_{3q,y}}{F_{3q,x}}$$

So resultant in this case would be

$$F = 14.8k\frac{Q^2}{l^2}$$

$$\theta = 332^0$$