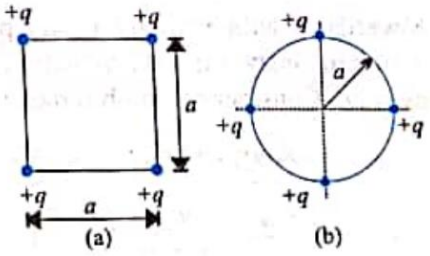
Ch—02 Electrostatic Potential and Capacitance
Daily Practice Problem 04

Q1. Consider the configuration of a system of four charges each of value +q. Find the work done by external agent in changing the configuration of the system from Fig. (a) to Fig. (b).

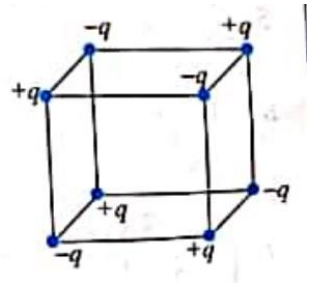


Ans. $-\frac{q^2}{4\pi\epsilon_0 a}(3-\sqrt{2})$

Q2. Four charges +q, -q, +q, and -q are placed in order on the four consecutive corners of a square of side a. Find the work done in interchanging the positions of any two neighboring charges of opposite sign.

Ans. $\frac{q^3}{4\pi\epsilon_0 a}(4-2\sqrt{2})$

Q3. Charges +q and -q are located at the corners of a cube of side as shown in figure. Find the work a done to separate the charges to infinite distance.

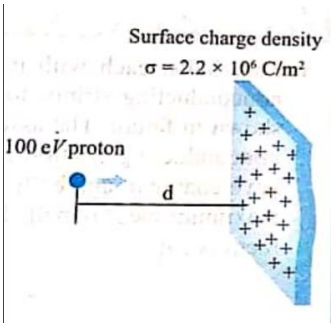


Ans. $\frac{1}{4\pi\epsilon_0}\frac{q^2}{a}\times\frac{4}{\sqrt{16}}[3\sqrt{3}-3\sqrt{6}-\sqrt{2}]$

Q4. Two charged particles having charge $1\mu C$ and —1μC and of mass 50 gm each are held at rest while their separation is 2 m. Find the speed of the particles when their separation is 1 m.

Ans. 3/10 m/s

Q5. A 100-eV proton is projected towards a large metal plate that has a surface charge density of$2.2\times10^{-6}C/m^2$. From what distance must the proton be projected, if it is to just fail to strike that plate?



Ans. 40 mm

Q6. A particle (A) having charge Q and mass m is at rest and is free to move. Another particle (B) having charge q and mass m is projected from a large distance towards the first particle with speed u.

(a) Calculate the least kinetic energy of the system during the subsequent motion.

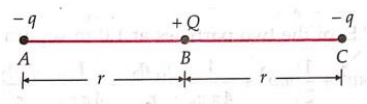
(b) Find the final velocity of both the particles. Consider coulomb force only.

Ans. a. $\frac{1}{4}mu^2$ **b**. A will move to right with velocity u and B will be at rest

Q7. A particle (A) having charge Q and mass m and another particle (B) having charge q and mass m are initially held at a distance $r = \frac{qQ}{2\pi\epsilon_0 mu^2}$ apart. Particle B is projected directly towards A with velocity u and particle A is released simultaneously. Find the velocity of particle A after a long time. Consider coulomb force only.

Ans. $\frac{1+\sqrt{3}}{2}\,u$

Q8. Three charges -q, +Q and -q are placed at equal distances on a straight line. If the potential energy of the system of three charges is zero, find the ratio Q / q.



Ans. 1: 4.

Q9. Two-point charges A and B of values $+15\mu C\ and\ +9\mu C$ are kept 18 cm apart in air. Calculate the work done when charge B is moved by 3 cm towards A.

Ans. 1.35 J

Q10. Two charges, of magnitude 5 nC and — 2 nC, are placed at points (2 cm, 0, 0) and (x cm, 0, 0) in a region of space, where there is no other external field. If the electrostatic potential energy of the system is -0.5μJ , what is the value of x

Ans. x = 4 cm

Q11. Three-point charges + q, + 2q and Q are placed at the three vertices of an equilateral triangle. Find the value of charge Q (in terms of q), so that electric potential energy of the system is zero.

Ans. Q = — 2q / 3