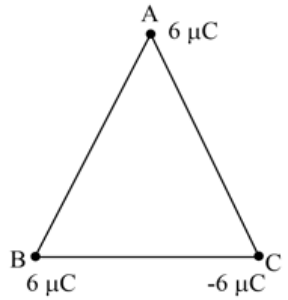
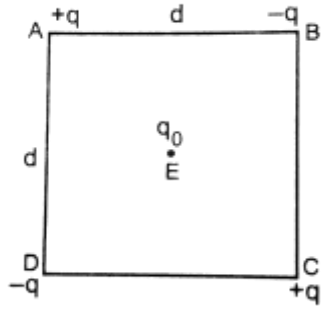
Questions Based on Electric Potential Energy

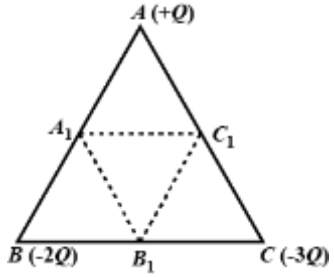
1. Two point charges $+10\mu C$ and $-10\mu C$ are separated by a distance of $2.0\ cm$ in air. (a) Calculate the potential energy of the system, assuming the zero of the potential energy to be at infinity.
2. Two point charges A and B of values $+15\mu C$ and $+9\mu C$ are kept $18\ cm$ apart in air. Calculate the work done when charge B is moved by $3\ cm$ towards A.
3. Two positive point charges of $0.2\ \mu C$ and $0.01\mu C$ are placed $10\ cm$ apart. Calculate the work done in reducing the distance to $5\ cm$.
4. Two point charges 20×10^{-6} C and -4×10^{-6}C are separated by a distance of $50\ cm$ in air. (i) Find the point on the line joining the charges, where the electric potential is zero. (ii) Also find the electrostatic potential energy of the system.
5. 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, what is the ratio $Q:q$?
6. 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.
7. Find the amount of work done in arranging the three point charges, on the vertices of an equilateral triangle ABC, of side $10\ cm$, as shown in figure.



8. Four charges are arranged at the corners of a square $ABCD$ of side d as shown in fig. (i) Find the work required to put together this arrangement. (ii) A charge q_0 is brought to the centre E of the square, the four charges being held fixed at its corners. How much extra work is needed to this?



9. Three point charges $+Q, +2Q$ and $-3Q$ are placed at the vertices of an equilateral triangle ABC of side l. If these charges are displaced to the midpoints A_1, B_1 and C_1 respectively, find the amount of the work done in shifting the charges to the new locations.



10. (a) Two point charges $+Q_1$ and $-Q_2$ are placed r distance apart. Obtain the expression for the amount of work done to place a third charge Q_3 at the midpoint of the line joining the two charges.

    (b) At what distance from charge $+Q_1$ on the line joining the two charges (in terms of Q_1, Q_2 and r) will this work done be zero?

11. Two identical particles, each having a charge of 2.0×10^{-4} C and mass of $10\ g$, are kept at a separation of $10\ cm$ and then released. What would be the speeds of the particles when the separation becomes large?

12. Two particles have equal masses of $5.0\ g$ each an opposite charges of $+4 \times 10^{-5}$ C and -4×10^{-5} C. They released from rest with a separation of $1.0\ m$ between them. Find the speeds of the particles when the separation is reduced to $50\ cm$.

13. (a) Determine the electrostatic potential energy of a system consisting of two charges $7\mu C$ and $-2\mu C$ (and with no external fields) placed at $(-9\ cm, 0, 0)$ and $(9\ cm, 0, 0)$ respectively.

    (b) How much work is required to separate the two charges infinitely away from each other?

    (c) Suppose the same system of charges is now placed in an external electric field $E = A\left(\frac{1}{r^2}\right); A = 9 \times 10^5\ \mathrm{Cm}^{-2}$. What would be the electrostatic energy of the configuration would be ?

Answers:

1.	2.	3.	4.
-45 J	1.35 J	1.8×10^{-4}J	(i) $41\ cm$ from the charge of 20×10^{-6} C (ii) -144 J
5.	6.	7.	8.
1: 4	$Q = -2q/3$	-3.24 J	0
9.	10.	11.	12.
$-\frac{1}{4}\pi\varepsilon_0.\frac{7Q^2}{l}$	$x = \frac{rQ_1}{Q_1 + Q_2}$	$600\ ms^{-1}$	$53.67\ ms^{-1}$
13.			
(a) -0.7 J (b) 0.7 J (c) 49.3 J			