Electrostatics

I. Charge and Force
- concepts and definition
- Coulomb's Law

II. Electric Fields
- effect on charge
- production by charge

III. Potential
- relation to work, energy, field
- association with charge

	The student will be able to:	HW:
1	Relate electrical phenomena to the motion and position of the fundamental charge found on electrons and protons and recognize the coulomb as the SI unit of charge and *e* as the elementary quantum of charge. ✓	1 – 5
2	State and apply Coulomb's Law to solve problems relating force, charge, and distance. ✓	6 – 13
3	Define and apply the concept of an electric field and sketch field lines for a given distribution of charge and solve for the electric field strength at any point relative to a collection of point charges. ✓	14 – 22
4	Define electric potential and potential difference and the volt and solve problems relating electric potential to charge, work or energy, electric field strength and distance. ✓	23 – 32
5	Define and calculate potential and isolines for common charge distributions and solve related problems.	33 – 38

Electric Potential vs. Source Charge

$$V = k\frac{q}{r} \quad \text{OR} \quad V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

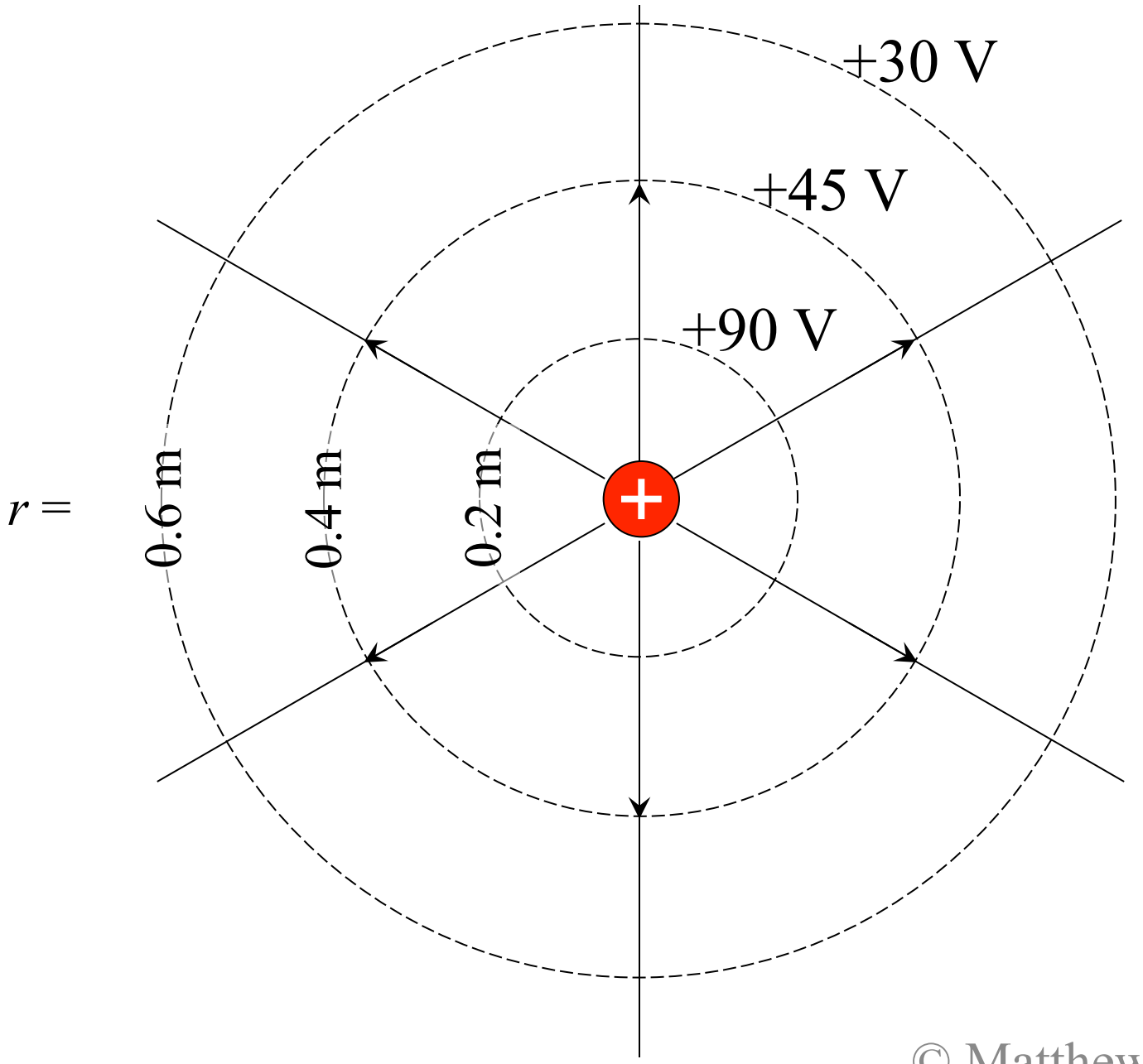
where: V = electric potential

r = distance from center of charge

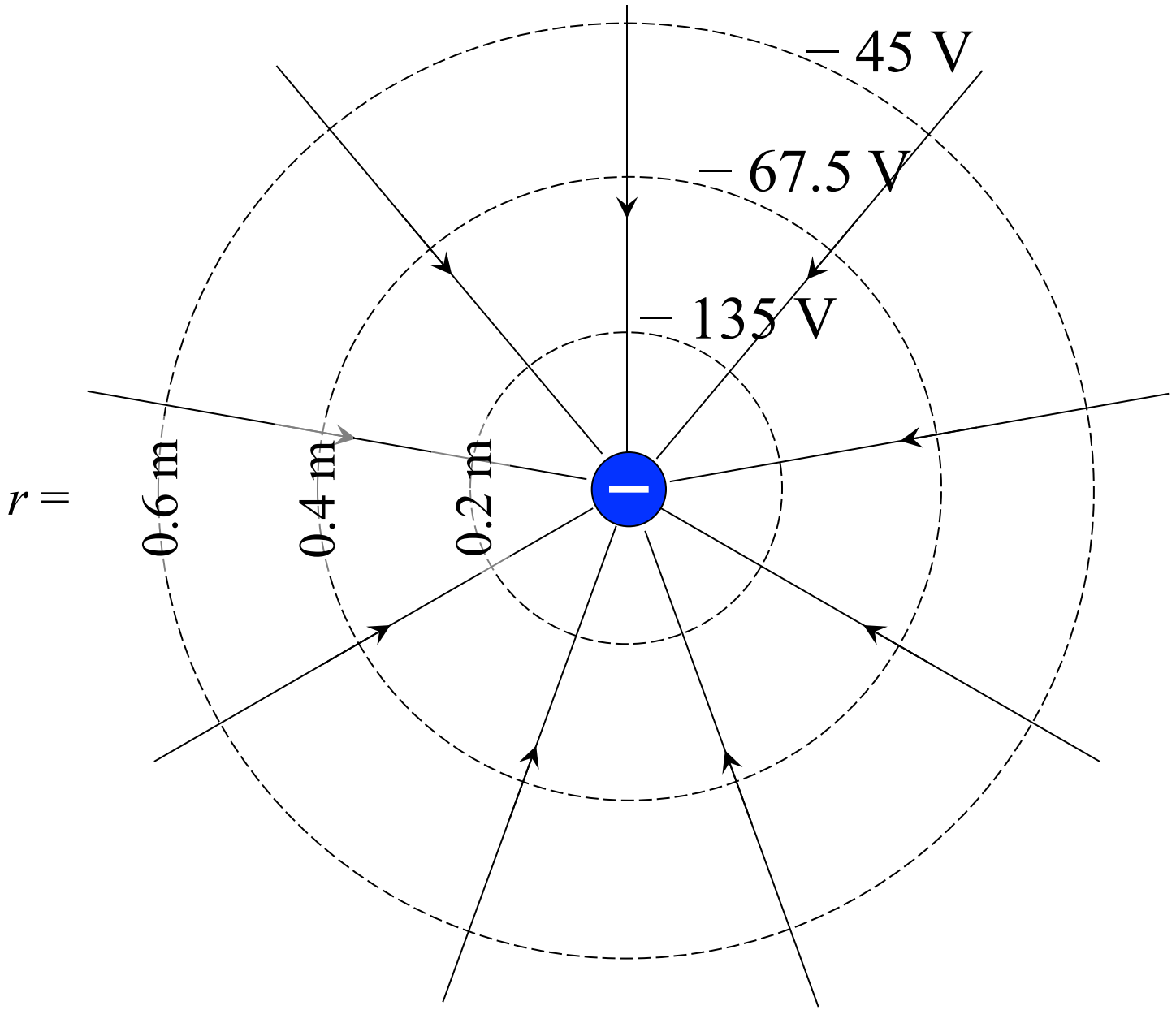
q = source of field and potential

note: q must be "point-like" or have spherical symmetry

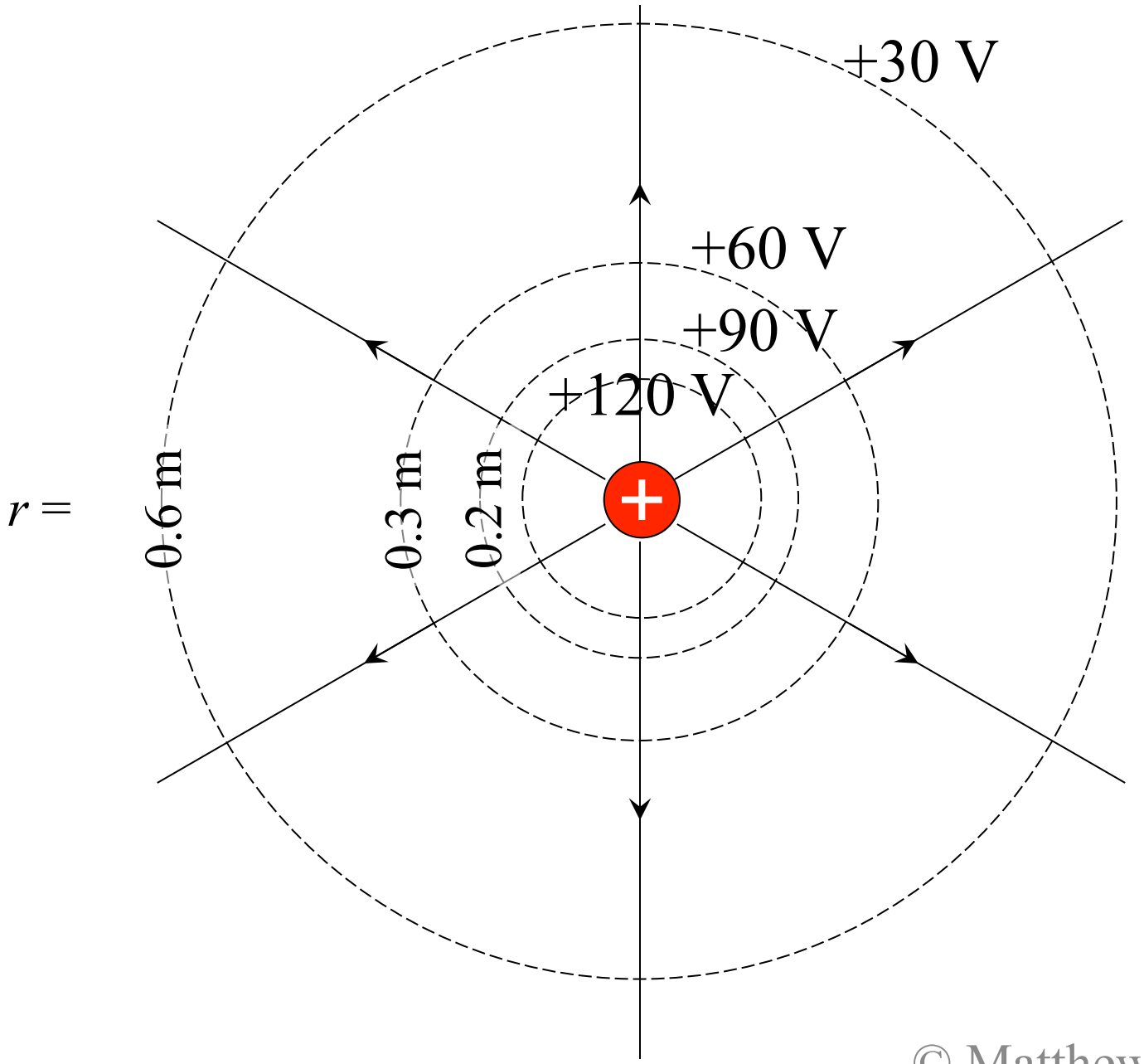
Equipotentials around a charge of +2 nC



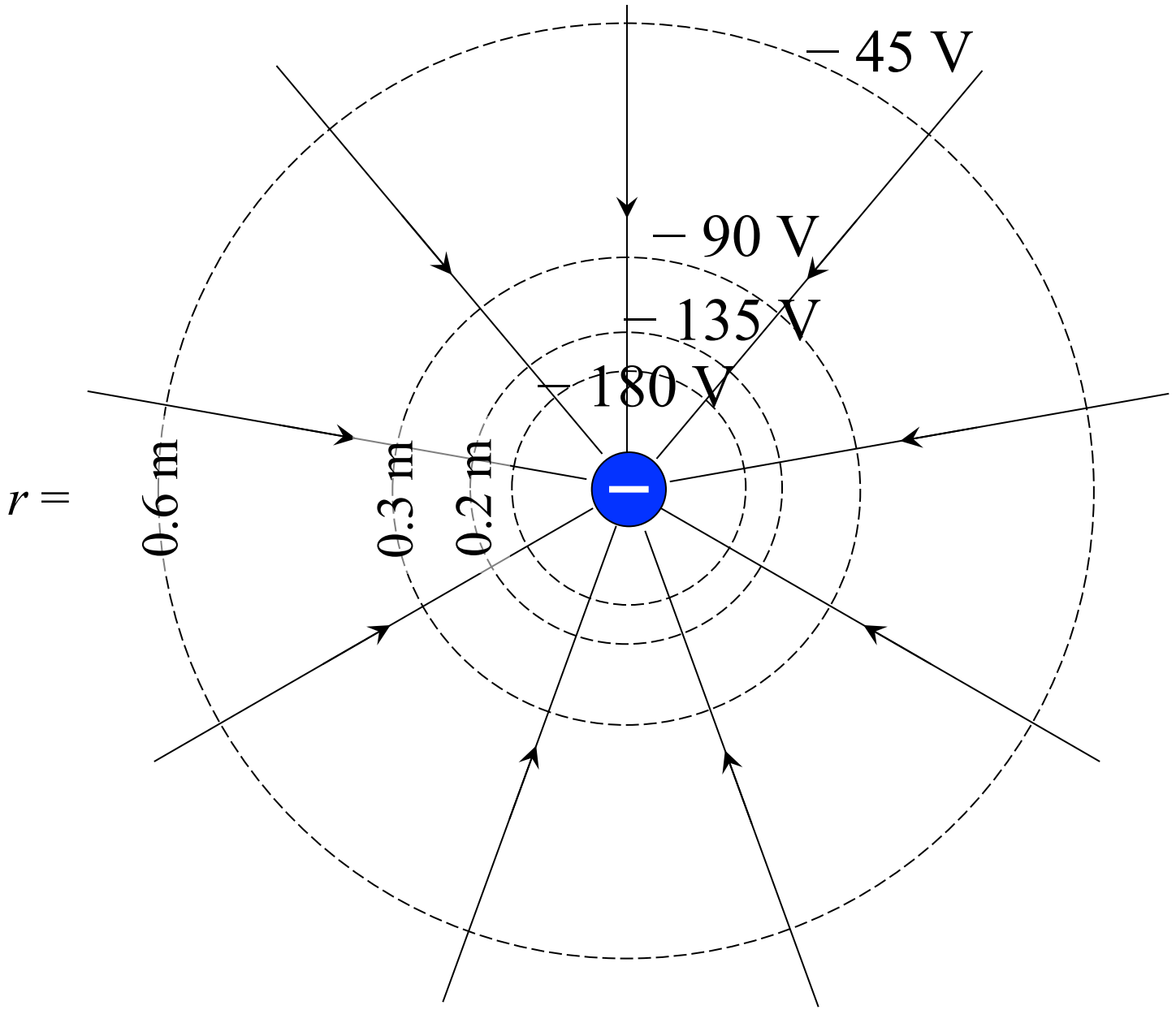
Equipotentials around a charge of −3 nC



Equipotentials around a charge of +2 nC



Equipotentials around a charge of −3 nC



Electric Potential Reference Level

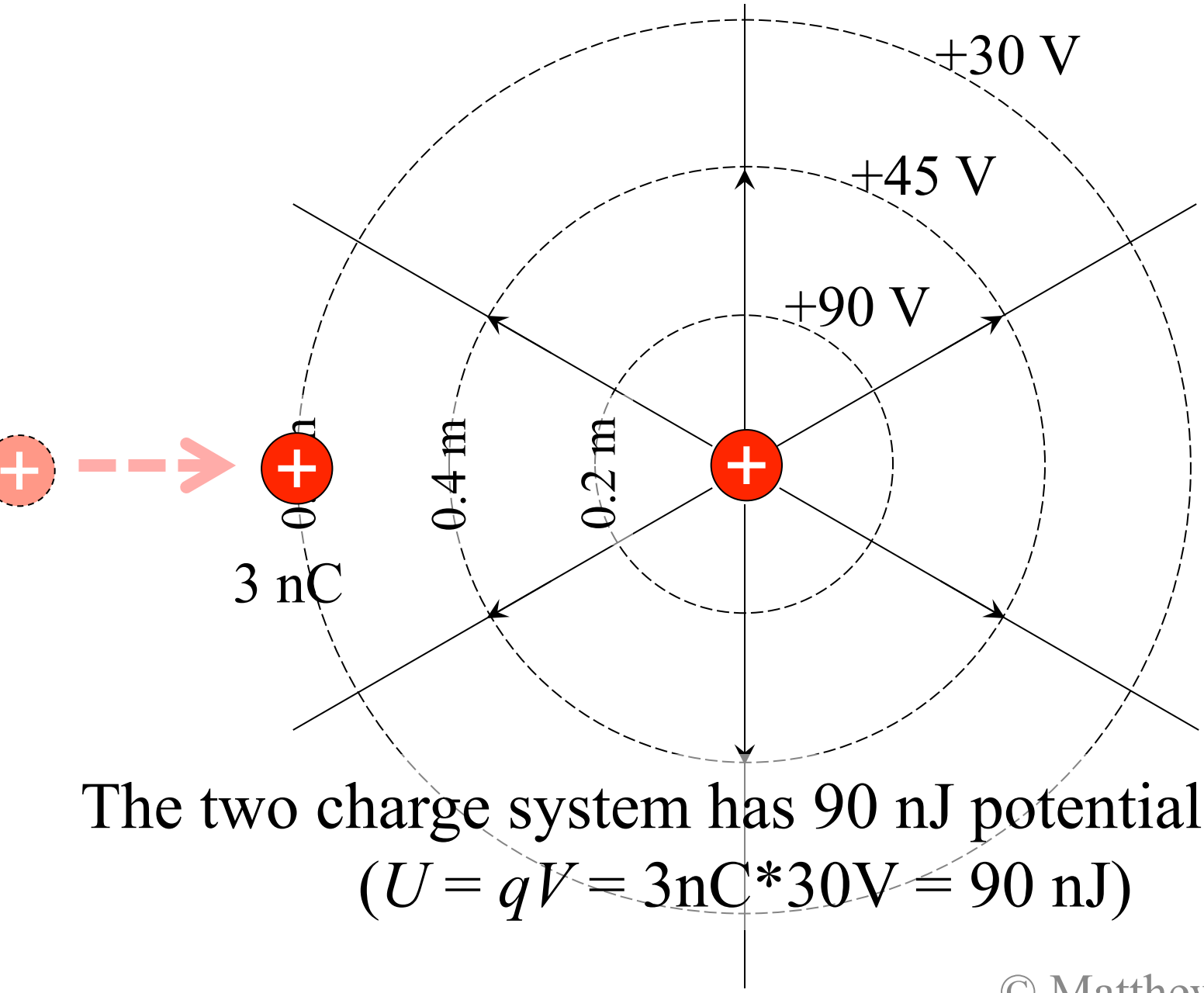
$$V = k\frac{q}{r}$$

What happens to the value of V as the value of r increases? Where is V equal to zero?

At great distances from a charge the electric potential defined by this formula drops to essentially zero. The reference for potential is r equal infinity!

Values calculated with this formula are *relative* to great distances from the charge.

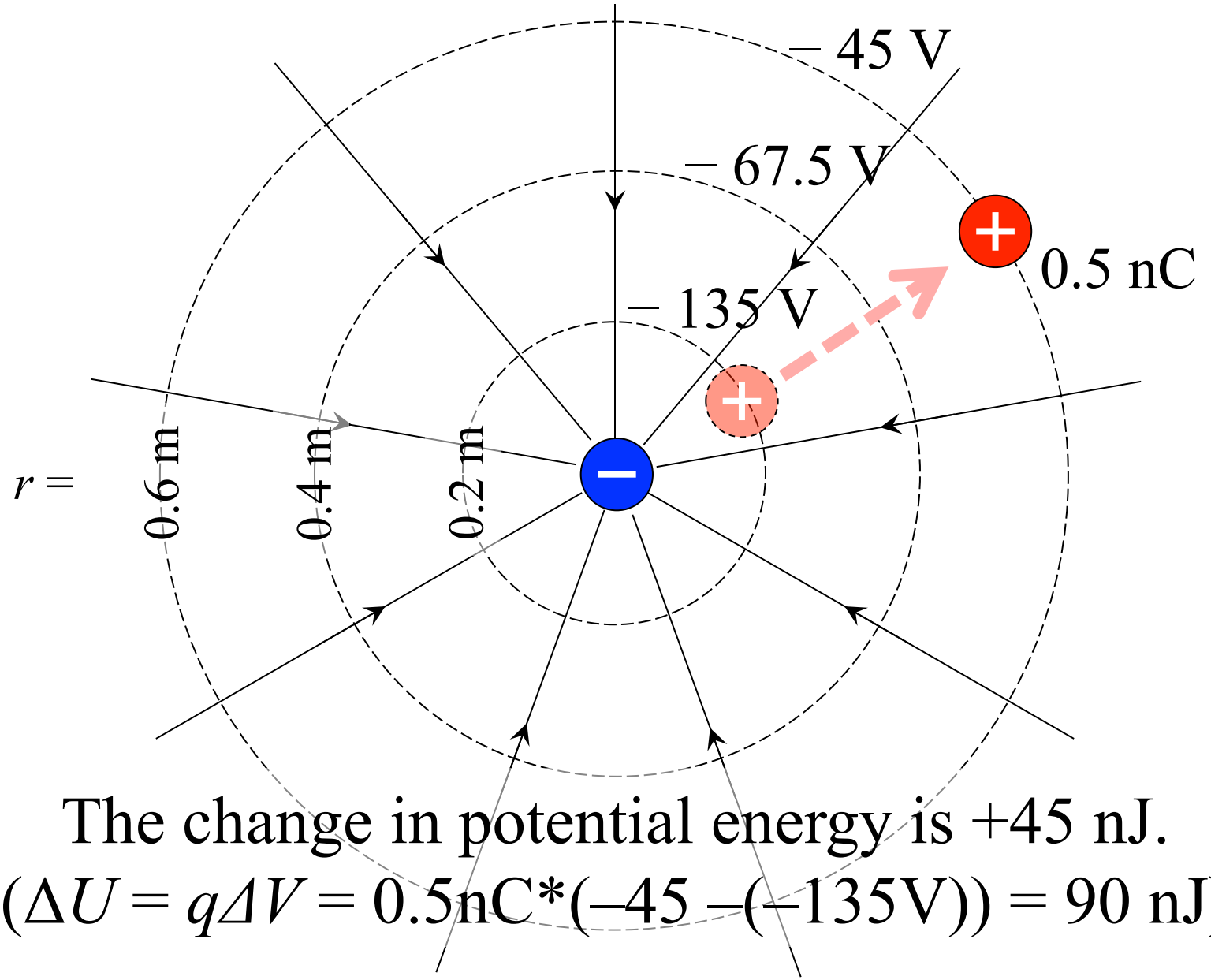
How much potential energy?



The two charge system has 90 nJ potential energy.

($U = qV$ = 3nC*30V = 90 nJ)

How much change in potential energy?



The change in potential energy is +45 nJ.

($\Delta U = q\Delta V$ = 0.5nC*(–45 –(–135V)) = 90 nJ)