For sum of charges

$$V = \frac{E_P}{q'} = k \sum \frac{q}{r}$$

+ of course for dist'n of charge

$$V = k \int \frac{dq}{r}$$

and we can see that $V \to 0$ as $r \to \infty$. Let's put some numbers in and see how all of this works

Point charge:

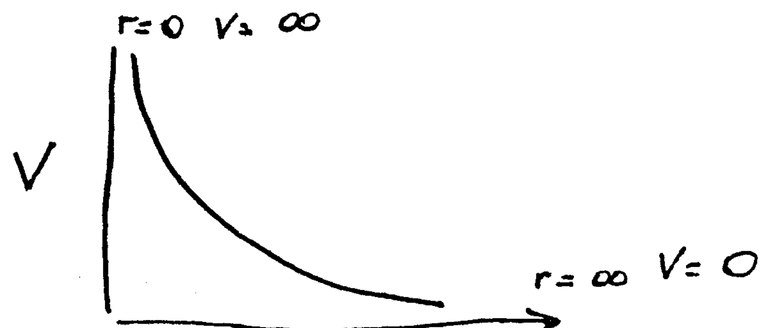
$$V = k \frac{q}{r}$$

$q = 1 \mu C \quad r = 1 m$

$$V = 9 \times 10^9 \, N m^2 C^{-2} \cdot \frac{1 \mu C}{1 m}$$

$$= 9 \times 10^3 \, N m C^{-1}$$

Remember $1 Nm = 1 J \Rightarrow V = 9 \times 10^3$ volts



e.g. Place a positron at $r = 1\,m$ what happens at $r = 2\,m$

$+\ 1\mu C \quad \bullet \longrightarrow \bullet$

$\overrightarrow{E}$

$F = qE$

$a = \frac{qE}{m}$

$r = 1\,m$	$r = 2\,m$
$V = 9000\,V$	$V = 4500\,V$
$PE = qV$	$PE = 0.72 \times 10^{-15}\,J$
$= 1.6 \times 10^{-19} C \cdot 9000 V$	
$= 1.4 \times 10^{-15}\,J$	

$$KE + PE = \text{const}$$

$$\frac{1}{2} m v^2 = -\Delta PE = q(V_{1m} - V_{2m})$$

$$= 0.72 \times 10^{-15}\,J$$

$$v = \sqrt{\frac{2 \cdot 0.72 \times 10^{-15}\,J}{9 \times 10^{-31}\,kg}}$$

$$= 4 \times 10^{7}\,m\,s^{-1} \qquad (13\%\,c!)$$

n.b. could do

$$v = \int a\,dt = \frac{q}{m}\int E\,dt =$$

We will see that it is really only POTENTIAL DIFFERENCE - difference in PE per unit charge between two locations that is important (Just as it is most often only the difference in PE between height "h" and the surface of the earth

$$mgh \approx Gm_e \left(\frac{1}{r_e} - \frac{1}{r} \right)$$

Potential difference

$$\frac{W_{a \to b}}{q'} = \frac{PE_b - PE_a}{q'} = V_b - V_a$$

Since $W_{a \to b} = -\int_a^b q' E_{\parallel} \, ds$

$$V_b - V_a = -\int_a^b E_{\parallel} \, ds$$ since $\vec{F}$ opposite direction to $\vec{E}$

or

$$\boxed{V_{ab} = V_a - V_b = \int_a^b E_{\parallel} \, ds}$$

$V_a - V_b$ is POTENTIAL DIFFERENCE between a + b

POTENTIAL of A wrt B

VOLTAGE of A wrt B

$$V_{ab} = V_a - V_b = -(V_b - V_a) = -V_{ba}$$