[$1eV = 1.6 \times 10^{-19}$ J]

Electric Force $= \dfrac{Q_1 Q_2}{4\pi \varepsilon_0 r^2}$

Electric Field Strength $= \dfrac{\text{Force}}{\text{Charge}} = \dfrac{Q_1}{4\pi\varepsilon_0 r^2}$

Electric Potential Energy (Joules or eV) $=$ Force x distance $= \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r}$

Electric Potential (volts) $= \dfrac{kQ}{r} = \dfrac{Q}{4\pi\varepsilon_0 r}$ [Potential energy per unit charge]

① Graph: Potential vs distance

→ gradient $= \dfrac{\frac{Q}{4\pi\varepsilon_0 r}}{r} = \dfrac{Q}{4\pi\varepsilon_0 r^2}$ = Field strength. $\left(E = \dfrac{V}{d}\right)$

→ area $= Q/4\pi\varepsilon_0 r \times r = Q/4\pi\varepsilon_0 = kQ$ = nothing!

② Graph: Energy vs distance

→ gradient $= \dfrac{\frac{Q_1 Q_2}{4\pi\varepsilon_0 r}}{r} = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$ = Force.

→ area $= \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r} \times r = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0}$ = nothing!

③ Graph: Force vs distance

→ gradient $= \dfrac{\frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}}{r} = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r^3}$ = nothing!

→ area $= \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r^2} \times r = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 r}$ = energy.

$E = \dfrac{F}{q} = \dfrac{V}{d}$ ∴ $F = \dfrac{qV}{d}$ → uniform electric field 

otherwise radial electric field 

HOMEWORK

Graph ④: Field strength vs distance

gradient = $\dfrac{\frac{Q}{4\pi\varepsilon_0 r^2}}{r}$ = $\dfrac{Q}{4\pi\varepsilon_0 r^3}$ = ~~potential~~ nothing!

area = potential difference

= $\dfrac{Q}{4\pi\varepsilon_0 r^2} \times r$ = $\dfrac{Q}{4\pi\varepsilon_0 r}$ = potential.