

2.5 General Charge Distributions

⊕
point charge

⊖
point charge

General charge distribution

along a line

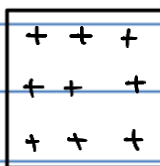
$$\lambda = \frac{q}{L} = \frac{dq}{dL}$$



line

over
surface

$$\sigma = \frac{q}{A} = \frac{dq}{dA}$$

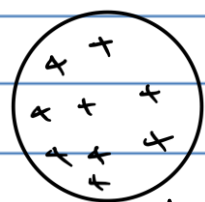


or

conducting sphere

through
Volume

$$\rho = \frac{q}{V} = \frac{dq}{dV}$$



Non-Conducting
sphere

λ : linear charge density

C/m

or C·m⁻¹

σ : surface charge density

C/m²

or C·m⁻²

ρ : volume charge density

C/m³

or C·m⁻³

$$dq = \lambda dx$$

$$dq = \sigma dA$$

$$dq = \rho dV$$

$$q = \int \lambda dx$$

$$q = \int \sigma dA$$

$$q = \int \rho dV$$

$$\lambda = -5 \text{ nC/m}$$

every one meter length has
a charge -5 nC

$$\sigma = -5 \text{ nC/m}^2$$

every 1 m^2 area has a charge
of -5 nC

$$\rho = -5 \text{ nC/m}^3$$

every 1 m^3 volume has a charge
of -5 nC

L : Length (m)

A : area (m^2)

V : Volume (m^3)

sphere: $A = 4\pi r^2$

sphere: $V = \frac{4}{3}\pi r^3$

$$\text{cm} \xrightarrow[\div 100]{\times 10^{-2}} \text{m}$$

$$\text{cm}^2 \xrightarrow{\times 10^{-4}} \text{m}^2$$

$$\text{cm}^3 \xrightarrow{\times 10^{-6}} \text{m}^3$$

for point charge:

$$E = \frac{kq}{r^2}$$

for charge distribution:

$$dE = \frac{k dq}{r^2}$$

$$E = \int \frac{k dq}{r^2}$$

$$\left\{ \begin{array}{l} dq = \lambda dx \quad \text{Line} \\ dq = \sigma dA \quad \text{Surface} \\ dq = \rho dV \quad \text{Volume} \end{array} \right.$$

2.5 General Charge Distributions التوزيعات العامة للشحنة

1	
What is the unit of measuring the liner density (λ) on a thin rod ? وحدة قياس كثافة الشحنة الخطية (λ) الموجودة على سلك رفيع وطويل ؟	
C/m	C/m ²
C/m ³	C/s

2			
What does X represent in the formula: $dq = X dV$ And what is its unit of measurement?		ماذا تمثل X في الصيغة: $dq = X dV$ وما وحدة قياسها؟	
	Symbol X	Unit	
	Linear charge density	C/m	
	Surface charge density	C/m ²	
	Volume charge density	C/m ³	
	Volume charge density	C/m ⁴	

3	
كرة موصلة نصف قطرها 3cm وشحنتها 5 nC . ما مقدار كثافة الشحنة السطحية؟ A conducting sphere has a radius 3cm and a total charge 5 nC What is the magnitude of surface charge distribution σ ?	

4

كرة غير موصلة نصف قطرها 3cm وتوزع على حجمها بانتظام شحنة 5 nC . ما مقدار كثافة الشحنة الحجمية لها؟

A non-conducting sphere with a radius of 3 cm and a charge of 5 nC uniformly distributed over its volume. What is its volume charge distribution ρ ?

5

Which of the following equations express the total charge distributed on a surface?

أي المعادلات التالية تعبر عن الشحنة الكلية موزعة على سطح؟

$$q = \int \lambda dx$$

$$q = \int q dr$$

$$q = \int \rho dV$$

$$q = \int \sigma dA$$

2.5 General Charge Distributions التوزيعات العامة للشحنة

1	
What is the unit of measuring the linear density (λ) on a thin rod ? وحدة قياس كثافة الشحنة الخطية (λ) الموجودة على سلك رفيع وطويل ؟	
C/m $C \cdot m^{-1}$	C/m^2
C/m^3	C/s

2			
What does X represent in the formula: $dq = X dV$ $\oint$ And what is its unit of measurement?		ماذا تمثل X في الصيغة: $dq = X dV$ وما وحدة قياسها؟	
	Symbol X	Unit	
×	Linear charge density	C/m	
×	Surface charge density	C/m^2	
	Volume charge density	C/m^3	
	Volume charge density	C/m^4	

3	
كرة موصلة نصف قطرها 3cm وشحنتها 5 nC . ما مقدار كثافة الشحنة السطحية؟ A conducting sphere has a radius 3cm and a total charge 5 nC What is the magnitude of surface charge distribution σ ?	
$r = 3cm \div 100 = 0.03m$ $q = 5nC = 5 \times 10^{-9}C$	$\sigma = \frac{q}{A} : A = 4\pi r^2$ $\sigma = \frac{5 \times 10^{-9}}{4\pi(0.03)^2} = 4.4 \times 10^{-7} C/m^2$

4

كرة غير موصلة نصف قطرها 3cm وتوزع على حجمها بانتظام شحنة 5 nC . ما مقدار كثافة الشحنة الحجمية لها؟

A non-conducting sphere with a radius of 3 cm and a charge of 5 nC uniformly distributed over its volume. What is its volume charge distribution ρ ?

$$r = 3 \text{ cm} = 0.03 \text{ m}$$

$$q = 5 \times 10^{-9} \text{ C}$$

$$\rho = \frac{q}{V} : V = \frac{4}{3} \pi r^3$$

$$\rho = \frac{5 \times 10^{-9}}{\frac{4}{3} \times \pi (0.03)^3} = 4.4 \times 10^{-5} \text{ C/m}^3$$

5

Which of the following equations express the total charge distributed on a surface? A

أي المعادلات التالية تعبر عن الشحنة الكلية موزعة على سطح؟

$$q = \int \lambda \, dx$$

$$q = \int q \, dr$$

$$q = \int \rho \, dV$$

$$q = \int \sigma \, dA$$