جامعة الموصل
كلية العلوم – قسم الفيزياء

المستوى الاول
المقرر 103
مبادئ الكهربائية والمغناطيسية

الاستاذ الدكتور
ليث محمد الطعان
٢٠١٩-٢٠٢٠

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الجهد الكهربائي
Electric Potential

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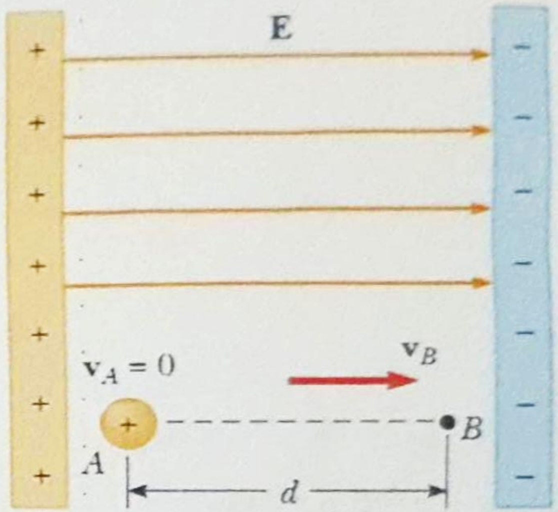
المحاضرة 5

ELECTRIC POTENTIAL

Let we imagine a small positive charge **+q** placed at reference point A in a uniform electric field, the work on the charge +q required to move it to a given point B against an electric field **E** called (**electric potential)** and is equal to:



$$W_{AB} = F_x \Delta x = qE\Delta x$$

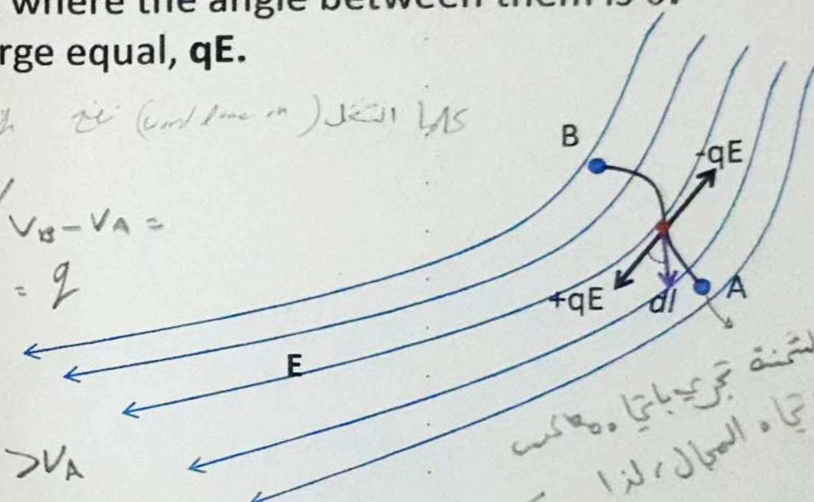
The electric potential is a **scalar** and measured in: **joules / coulomb** or (**volts**).

Notes:

i) Here the test charge must be very small.
ii) Always there must be a reference point.
iii) Because the electric field is conservative, the change in potential energy doesn't depend on the path

Electric Potential, in non–uniform field

To calculate the work done to move the charge from A to B,
We have to integrate along the path ***dl***, from A to B.
Let the strength of the field is **E**, where the angle between them is θ.
There is a force **F** act on the charge equal, **qE**.
So the work done is:



$$W_{AB} = \int_A^B F.dl = -q\int_A^B E.dl$$

$$V_A - V_B = -q\int_A^B E.dl$$

$$if\ A \rightarrow \infty \quad so\ V_A = 0$$

$$V_B = -q\int_\infty^B E.dl$$

اذن يمكن حساب قيمة الجهد الكهربائي اذا علمنا قيمة شدة المجال

وفي حالة كون المجال منتظما فان المعادلة الاخيرة يمكن تبسيطها بدلالة الزاوية. ففي المجال المنتظم ستكون الزاوية بين المسار والمجال 180درجة

$$V_A - V_B = -\int_A^B E \cos\theta \, . dl = -\int_A^B E \cos 180 \, dl = -E \int_A^B dl$$

اذا كانت المسافة بين النقطتين تساوي d

$$V_A - V_B = Ed$$

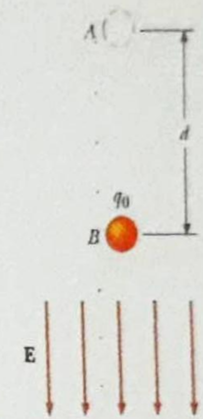
$V_B = -q \int_A^B E \cos\theta \, dl$

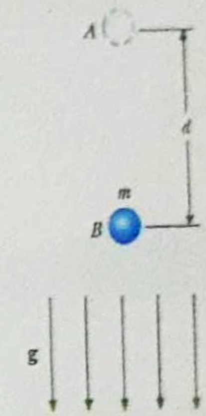
Electrical potential ... Gravitation

Electric and gravitational potential energy can be compared. Here we see that positive charge in an electric field acts very much like mass in a gravity field

(a) When the **electric field** is directed downward, B is at a lower electric potential than A. the electric potential energy <u>decreases</u>. تنخفض

(b) An object of mass moves in the direction of the **gravitational** field, the gravitational potential energy <u>decreases</u>





From <u>conservation of energy</u>, in falling from point A to point B the positive charge **gains** تكتسب <u>kinetic energy</u> equal in magnitude to the **loss** of electric <u>potential energy</u>.
بسبب قانون حفظ الطاقة فانه عند سقوط الشحنة من نقطة الى اخرى تكتسب طاقة حركية في الوقت نفسه تفقد من طاقة الجهد الكهربائي

$$\Delta KE + \Delta PE_{el} = 0$$

$$\Delta KE = qEd \quad \text{------------(1)}$$

$$\Delta KE + \Delta PE_{g} = 0$$

$$\Delta KE = mgd \quad \text{------------(2)}$$

So for +q charges, electric potential energy works like gravitational potential energy. In both cases, moving an object opposite the direction of the field results وينتج عنه in a gain of potential energy, the potential energy is converted تحويل الى to the object's kinetic energy