A Level H2 Physics Tutorial 13: Electric Fields

Syllabus :

(a) show an understanding of the concept of an electric field as an example of a field of force and define electric field strength at a point as the electric force exerted per unit positive charge placed at that point

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1. (a) State what an electric field is.

(b) What is the definition of electric field strength?

(b) represent an electric field by means of field lines

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2. (a) What are electric field lines?

(b) Sketch the electric field lines around

(i) a negative point charge,

(ii) a positive point charge.

(c) recognise the analogy between certain qualitative and quantitative aspects of electric and gravitational fields

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3. (a) What are the similarities between the electric field and the gravitational field around a metal sphere?

(b) What are the differences?

(d) recall and use Coulomb's law in the form $F = Q_1Q_2 / 4\pi\varepsilon_0 r^2$ for the electric force between two point charges in free space or air

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4. An electric charge q_1 is 0.1C and another one q_2 is 0.2 C are at a distance of 0.5 m apart. Find the force on each charge.

(e) recall and use $E = Q / 4\pi\varepsilon_0 r^2$ for the electric field strength of a point charge in free space or air

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5. A point charge A is 0.1 C. A is a metal sphere. Find the force on a unit charge of 1 C at a distance of 0.5 m from A.

This force on a unit charge is called electric field strength.

(f) calculate the electric field strength of the uniform field between charged parallel plates in terms of the potential difference and plate separation

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6.

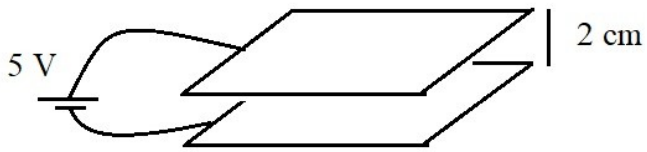

Figure 13.1

Find the electric field strength E between the metal plates above. Use the formula

$$E = V/d$$

where V is potential difference between the plates, and d is distance between them.

(g) calculate the forces on charges in uniform electric fields

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7. A tiny sphere with a charge of 0.1 C is placed in between the plates in the previous question. Find the electric force on the sphere.

(h) describe the effect of a uniform electric field on the motion of charged particles

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8.

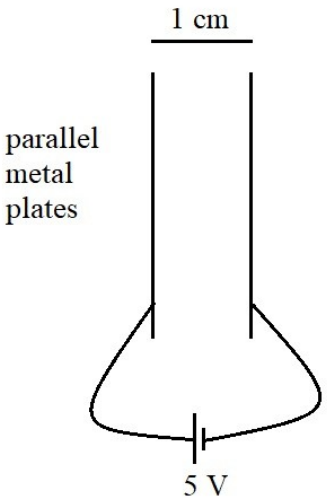

Figure 13.2

(i) Calculate the force F on the charge particle q. q is a proton.

(ii) Describe what happens to q when released from the positive plate. Assume that gravitational force can be neglected.

9.

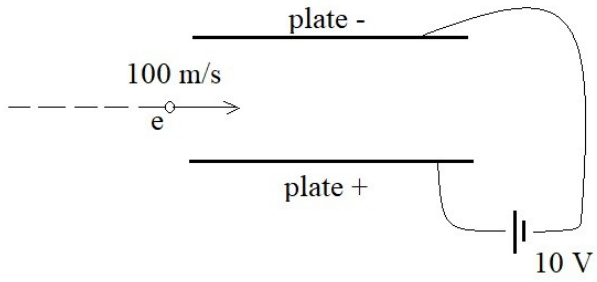

Figure 13.3

(i) e is an electron. Calculate the force on it.

(ii) Describe what happens to e as it travels between the plates.

(i) define the electric potential at a point as the work done per unit positive charge in bringing a small test charge from infinity to that point

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(k) use the equation $V = Q / 4\pi\varepsilon_0 r$ for the electric potential in the field of a point charge, in free space or air.

10.

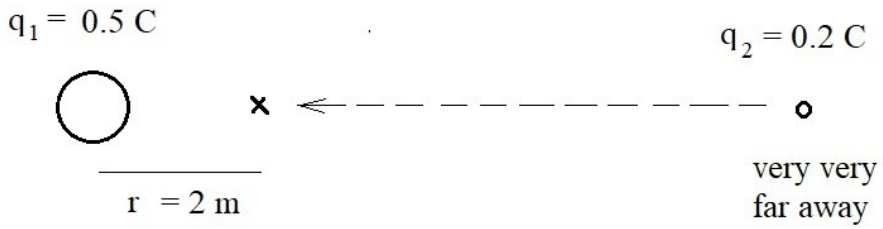

Figure 13.4

(i) What is the work done to bring a 0.2 C charge from infinity to a distance of 2 m from a 0.5 C charge? Use the formula $U = q_1q_2 / 4\pi\varepsilon_0 r$

[This work done from infinity is called "potential energy".}

(ii) What would be the work done if q_2 is 1 C instead??

[This work done from infinity is called "potential", formula $V = q / 4\pi\varepsilon_0 r$.
Note the difference between "potential energy" and just "potential".]

(j) state that the field strength of the electric field at a point is numerically equal to the potential gradient at that point

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11.

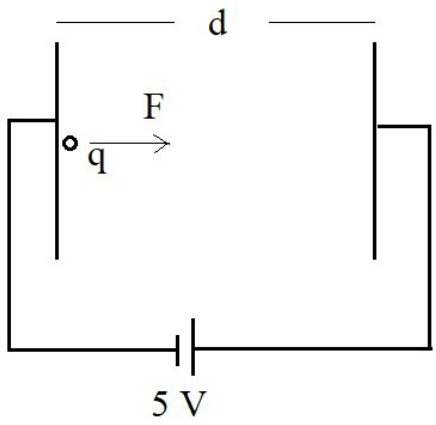

Figure 13.5

(i) What is the work W needed to bring a small sphere with charge q from metal plate A to metal plate B, given that q is 0.1 C. (Recall that potential difference V = W/q.)

(ii) Work W is also equal to force times distance moved in the direction of the force, Fd. Find F.

(iii) Electric field strength, E, is force per unit charge, F/q. Find the electric field strength between the plates.

(iv) Find an equation relating E, V and d.

(k) Use the equation $V = Q / 4\pi\varepsilon_0 r$ for the electric potential in the field of a point charge, in free space or air.

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12. The work done to bring a unit charge from infinity (very very far away) to a point A is called to potential at point A.

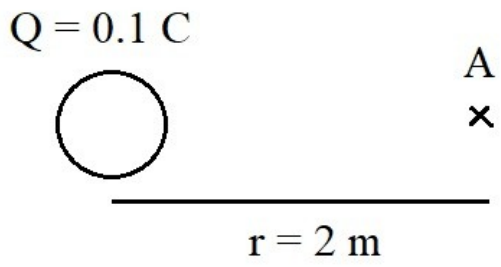

Figure 13.6

For the diagram above, find the potential at A.

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