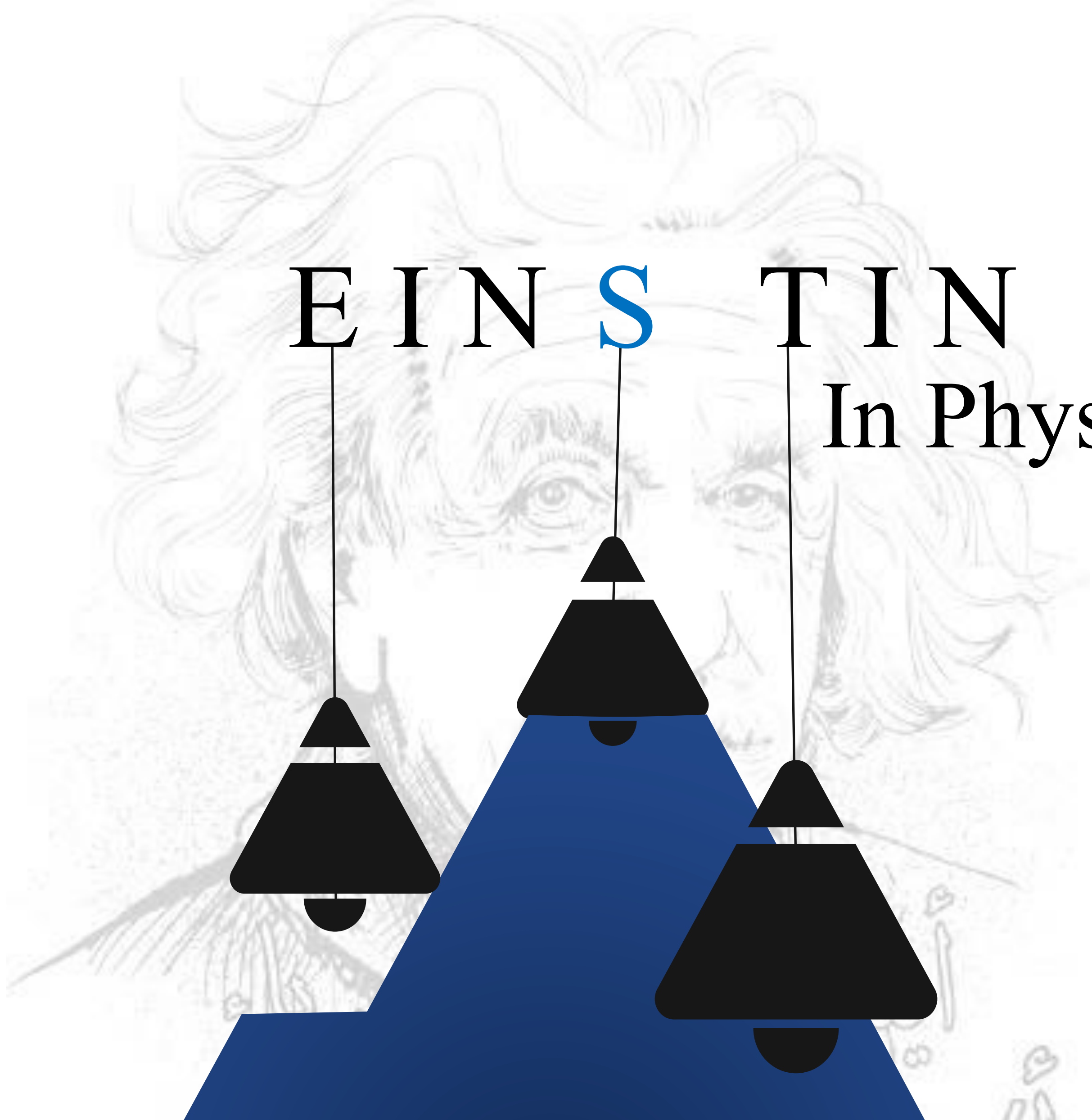
ملخص و تدريبات الوحدة الثانية Field Electric باللغة الانجليزية

اسم الطالب: ....

EINS TIN
In Physics



قديما كانت تمثل الفيزياء رعبا للطالب أما الآن
اسلوب جديد لعرض الفيزياء بعيدا عن التعقيد

UNIT 2

اللهم أني استودعتك مستقبلا لا اعلم خفاياه ولكني اعلم أنك خير مدبر

وخير من اودعت له الوداع اجعل القادم أجمل مما مضي يارب العالمين

1-Measuring Electric Field

2-Applications of Electric Fields

EXAM UNIT 2

اينشتاين في الفيزياء

Electric Field

2025

أ/ عبدالرحمن عصام
0509886279

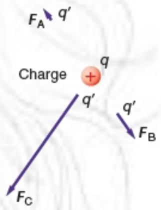
1 Measuring Electric Fields

Creating and Measuring Electric Fields: -

Electric field: the change in the properties of space that surround any electrically charged object, and experiences a force.
The forces exerted by electric fields can do work, transferring energy from the field to another charged object.
How can you measure an electric field?
Place a small charged object at some location.
If there is an electric force on it, then there is an electric field at that point.
Suppose you place the positive test charge at some point, A, andmeasure a force,
The strength of an electric field is equal to the force on a positive test charge divided by the strength of the test charge, F According to Coulomb's law, the force is directly proportional to the strength of the test charge, $\bar{q}$

Electric Field Strength $\vec{E} = \frac{\vec{F}}{q} = \frac{kq}{r^2}$

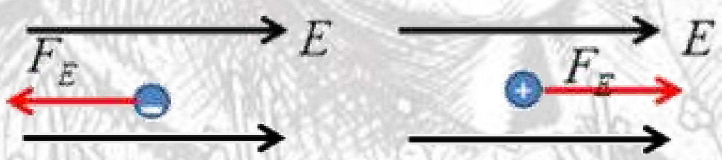
Unit of E is N/C



The direction of the force on a positive charge is always along (same)the electric field lines, and the direction of the force on a negative charge is in the opposite direction to the electric field lines.

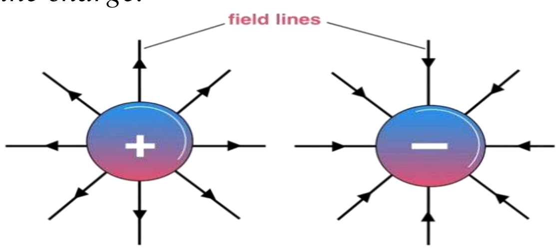
The magnitude of the electric field strength is measured in newtons per coulomb, N/C.
NOTE :*An electric field should be measured only by a very small test charge.*
This is because the test charge also exerts a force on q.

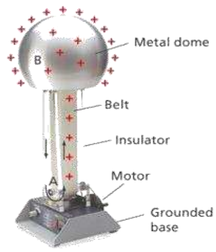
The direction of the force depends on the direction of the field and thesign of the charge.



Picturing the Electric Field:
The field lines emanate in radial direction from the point charge.

- *The direction of the field at any point is the tangent drawn to a field line at that point.*
- *If the point charge is positive the field lines point outward, away from the charge.*
- *if the point charge is negative the field lines point inward toward the charge.*
- *The strength of the electric field is indicated by the spacing between the lines.*
- *that the electric field lines are closer together near the point charge and farther apart away from the point charge, indicating that the electric field lines become weaker with increasing distance from the charge.*

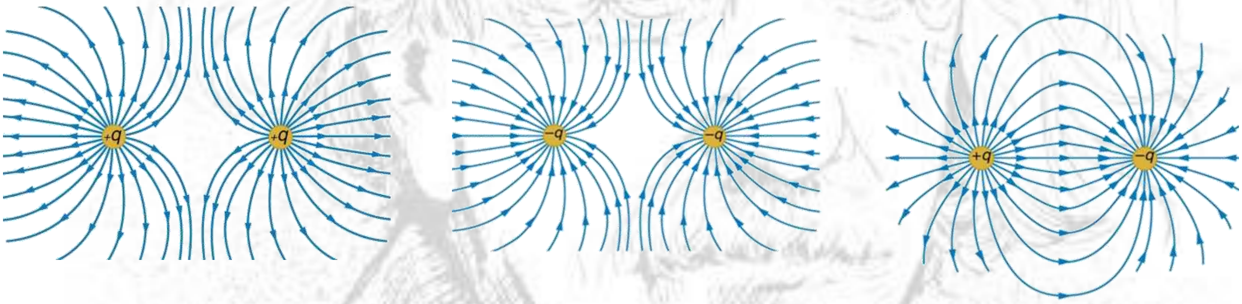




Van de Graaff's machine is a device that transfers large amounts of charge from one part of the machine to a metal terminal at the top of the device.
Charge is transferred onto a moving belt at the base of the generator, position A, and is transferred off the belt at the metal dome at the top, position B.
An electric motor does the work needed to increase the electric potential energy

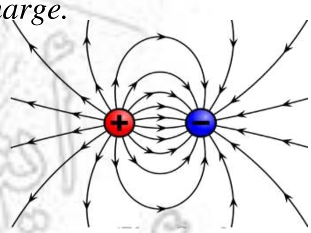
A person touching the terminal of a Van de Graaff machine is charged electrically. The charges on the person's hairs repel each other, causing the hairs to follow the field lines.

Another method of visualizing field lines is to use grass seed in an insulating liquid, such as mineral oil.The electric forces cause a separation of charge in each long, thin grass seed. The seeds then turn so that they line up along the direction of the electric field. The seeds form a pattern of the electric field lines, as shown in the bottom figure.



Properties of electric fields lines:-

it is direction inward into the negative charge and outward of the positive charge.
number of lines proportional with the electric field magnitude.
if we have two charge we can use;



$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

The field lines emanate in radial direction from the point charge.

- *The direction of the field at any point is the tangent drawn to a field line at that point.*
- *If the point charge is positive the field lines point outward, away from the charge.*
- *if the point charge is negative the field lines point inward toward the charge.*
- *The strength of the electric field is indicated by the spacing between the lines.*
- *that the electric field lines are closer together near the point charge and farther apart away from the point charge, indicating that the electric field lines become weaker with increasing distance from the charge.*

Check your understanding:

choose the correct answer:

1. *When a charge (-5μC) placed in an electric field it experiences a force from E equal2 mN to the North, what is the magnitude and direction of the electric field that affect the charge?*

ⓐ 400 N/C South ⓑ 400 N/C North ⓒ 100 N/C south ⓓ 2.5×10^{-3} N/C South

2. *A negative charge of (-2×10^{-10} C) experiences a force of 5×10^{-6} N to the right in an electric field. What are the field's magnitude and direction at that location?*

ⓐ 4×10^{-5} N/C to the right ⓒ 2.2×10^{4} N/C to the right

ⓑ 2.5×10^{4} N/C to the left ⓓ 1×10^{-15} N/C to the right

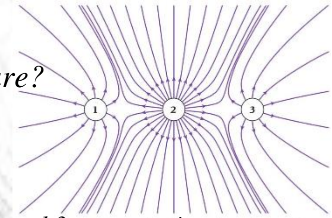
3. *A pith ball weighing 0.09 N is placed in a downward electric field of 5×10^{4} N/C. What charge (magnitude and sign) must be placed on the pith ball so that the electric force acting on it will suspend it against the force of gravity?*

ⓐ -2.3×10^{-7} C ⓑ 1.2×10^{-6} C ⓒ -1.8×10^{-6} C ⓓ 4500 C

4. *Which of the charges in the figure is (are) positive?*

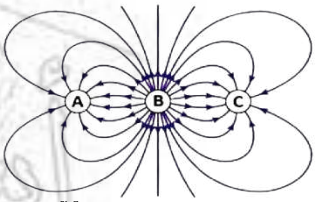
ⓐ A ⓑ B ⓒ C ⓓ A and C

5. *What are the signs of the charges in the configuration shown in the figure?*



ⓐ *1, 2, and 3 are negative.* ⓑ *1, 2, and 3 are positive.* ⓒ *1 and 3 are positive, and 2 is negative.* ⓓ *1 and 3 are negative, and 2is positive*

6. *the figure shows three charges placed at three points A , B and C Which of the following statements is correct about the charge (q) of A , B and C ?*

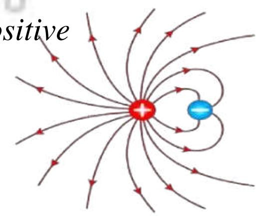


ⓐ $q_A = q_B$ ⓑ $q_A = q_C$ ⓒ $q_A = q_B = q_C$ ⓓ $q_A = -q_C$

7. *What is the possible value for q_1 and q_2 shown in the figure?*

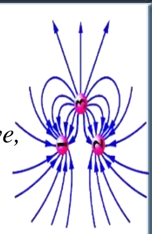
ⓐ $q_1=1C,\ q_2=-3C$ ⓑ $q_1=1C,\ q_2=3C$ ⓒ $q_1=3C,\ q_2=-1C$ ⓓ $q_1=-3C,\ q_2=1C$

8. *Considering the intensity of the electric field lines shown in the figure, if the positive charge is equal to (+ 24μC). What is the charge of the negative charge?*



ⓐ -48 μC ⓑ -12 μC ⓒ -6 μC ⓓ -24 μC

9. What are the signs of the charges in the configuration shown in the figure?

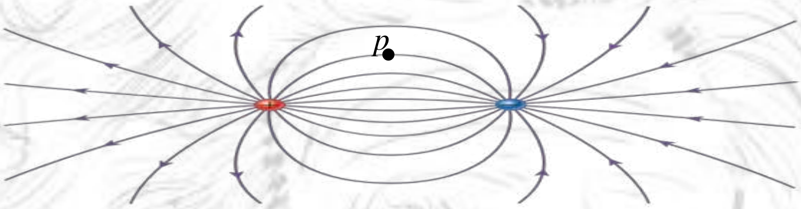


ⓐ 1, 2, and 3 are negative. ⓑ 1, 2, and 3 are positive. ⓒ 1 and 2 are positive, and 3 is negative. ⓓ 1 and 2 are negative, and 3is positive

10. A negative test charge -q is placed in an electric field. It will experience a net force as shown in the figure, what is the direction of the electric field at that point?

ⓐ To the left ⓑ To the right ⓒ Upward ⓓ Downward

11. The figure shows the electric field lines between two equal and opposite point charges, what is the direction of the electric force on a test charge placed at the point P in this field?

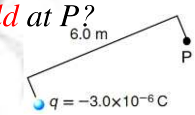


ⓐ To the left ⓑ To the right ⓒ Upward ⓓ Downward

12. The direction of the electric field is the direction of the__________.

ⓐ work done moving the test charge
ⓑ potential difference
ⓒ force on the negative test charge
ⓓ force on the positive test charge

13. The figure shows a point P at 6.0 m from a point charge q. What is the electric field at P?



ⓐ 750 N/c towards the charge ⓑ 750 N/c away from the charge ⓒ 4500 N/c towards the charge ⓓ 4550 N/c away from the charge

14. The electric field 0.25 m away from a point charge is 9.4×10^5 N/C. What is the magnitude of the charge?

ⓐ 1.6 μC ⓑ 6.5 μC ⓒ 1.6 C ⓓ 5.0 μC

15. A negative charge of 1.5×10^{-7} C experiences a force of 0.030 N to the right in an electric field. What is the magnitude and direction of the field?

ⓐ 4.5×10^{-7} N/C to the right ⓑ 2.0×10^{6} N/C to the right ⓒ 2.0×10^{6} N/C to the left ⓓ 4.5×10^{-7} N/C to the left

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16. the magnitude of the electric field at point 20 cm away from a point charge of -33nC?

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17. A negative charge of 5.0×10^{-9}C is placed at a point where the electric field is 1200 N/C to the right, what is the force exerted on charge at that point?

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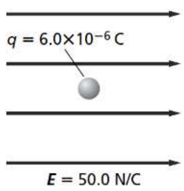
18. A positive test charge of 6.0×10^{-6} C is placed in an electric field of 50.0 N/C intensity, as in figure below. What is the strength of the force exerted on the test charge?



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19. What is the electric field strength 20.0 cm from a point charge of 8.0×10^{-6}C?

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20. What is the magnitude of the electric field strength at a position that is 1.2 m from a point charge of $4.2x10^{-6}$C?

B-What is the magnitude of the electric field strength at a distance twice as far from the point charge?

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21. What is the electric field at a position that is 1.6 m east of a point charge of $7.2x10^{-6}$ C?

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22. The electric field that is 0.25 m from a small sphere is 450 N/C toward the sphere. What is the charge on the sphere?

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23. How far from a point charge of $2.4x10^{-6}$ C must a test charge be placed to measure a field of 360 N/C?

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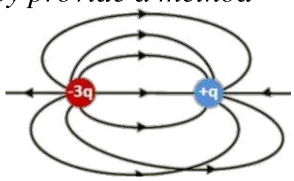
24. *Field lines do not really exist. They are simply a means of providing a model of an electric field. Electric fields, on the other hand, do exist. Although they provide a method of calculating the force on a charged body.*

mention three mistakes in the figure: -



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25. *How would the electric field strength change in these cases.*

A. *The test charge is doubled.*

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B. *The charge is doubled.*

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C. *The distance from the charge is doubled*

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D. *The distance from the charge is halved*

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E. *The charge is doubled.*

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F. *The charge is halved.*

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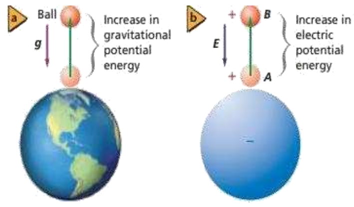
2 Applications of Electric Fields



Energy and Electric Potential The gravitational potential energy of a ball increase when it is lifted cause there is an outer work done by an external force. moving the ball opposite the gravitational field .

The situation is similar with two unlike charges: they attract each other, and so you must do work to pull one charge away from the other. When you do the work, you transfer energy to the charge where that energy is stored as potential energy. The larger the test charge, the greater the increase in its potential energy, ΔPE.

electric potential difference, ΔV, is defined as the work done moving a positive test charge between two points in an electric field divided by the magnitude of the test charge.

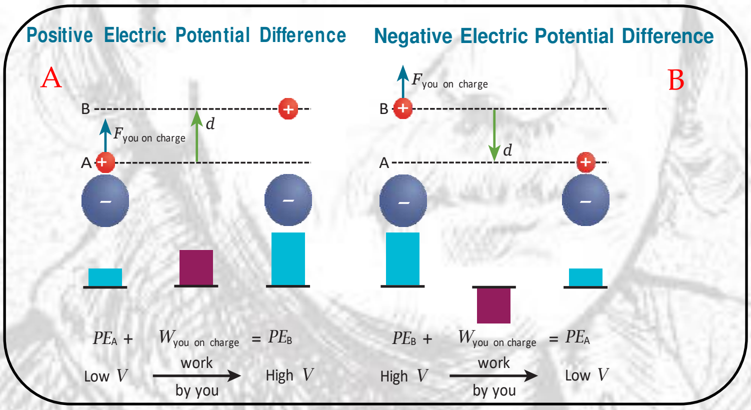
$$\Delta V = \frac{W_{on\ q'}}{q'}$$

Electric potential difference is determined by measuring the work per unit charge.

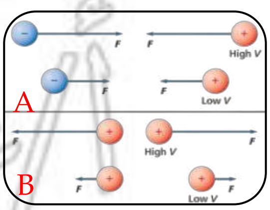
The difference in electrical potential:

" is the ratio of the work needed to move a charge to the strength of that charge."

Electric potential difference is measured in joules per coulomb. One joule per coulomb is called a volt $(V = J/C)$



If you move unlike charges apart, you increase the electric potential difference (a).
If you move unlike charges closer together, you reduce the electric potential difference (b).



- *Is there always an electric potential difference between the two positions?*

Suppose you move the test charge in a circle around the negative charge. The force that the electric field exerts on the test charge is always perpendicular to the direction in which you moved it, so you do no work. Therefore, the electric potential difference is zero.

Whenever the electric potential difference between two or more positions is zero, those positions are said to be at equipotential.

The electric potential difference from point A to point B is defined as $\Delta V = VB - VA$.

Electric potential differences are measured with a voltmeter.

Sometimes, the electric potential difference is simply called the voltage. Do not confuse electric potential difference, ΔV, with the unit for volts, V

Electric potential is smaller when two unlike charges are closer together (a) and larger when two like charges are closer together (b).

ΔV *is positive if the potential energy increase (moving opposite the* $\vec{E}$*)*

ΔV *is negative if the potential energy decrease (moving same direction as* $\vec{E}$*)*

What happens when a positive test charge is separated from a positive charge?

- *There is a repulsive force between these two charges.*
- *Potential energy decreases as the two charges are moved farther apart.*
- *Therefore, the electric potential is smaller at points farther from the positive charge.*

the potential energy of a system can be defined as zero at any reference point.
In the same way, the electric potential of any point can be defined as zero.

Usually $V\infty = 0$ *(voltage at infinity = 0)*

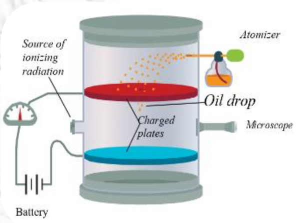
- *The Electric Potential in a Uniform Field*

A uniform electric force and field can be made by placing two large, flat, conducting plates parallel to each other.
One is charged positively and the other is charged negatively.
The electric field between the plates is constant, except at the edges of the plates, and its direction is from the positive to the negative plate.
Electric Potential Difference in a Uniform Field $\Delta V = Ed$
The electrical potential difference in a uniform field

"is equal to the product of electric field intensity and the distance moved by a charge."

The electric potential increases in the direction opposite the electric field Direction That is, the electric potential is higher near the positively charged plate.

- *Millikan's Oil-Drop Experiment:*



One important application of the uniform electric field between two parallel plates is the measurement of the charge of an electron.
1-fine oil drops were sprayed from an atomizer into the air.
2-These drops were charged by friction with the atomizer as they were sprayed.
3-Gravity acting on the drops caused them to fall, and a few of them entered the hole in the top plate of the apparatus.
4-An electric potential difference then was placed across the two plates.
The resulting electric field between the plates exerted a force on the charged drops.
5-When the top plate was made positive enough, the electric force caused negatively charged drops to rise. The electric potential difference between the plates was adjusted to suspend a charged drop between the plates.
6-At this point the downward force of Earth's gravitational field and the upward force of the electric field were equal in magnitude. $Fg = Fe$

$$mg = qE$$

$$q = \frac{mg}{E}$$

Millikan noted, however, that the changes in the charge on the drops were always a multiple of

$$1.60 \times 10^{-19}\ C.$$

This means that an object can have only a charge with a magnitude that is some integral multiple of the charge of an electron.

$q = \mp ne$ *, where* n*: integer number of electrons.* , $e = 1.6 \times 10^{-19}\ C.$

- ***Sharing of Charge:***

when a conductor is charged with a positive charge, due to the repulsive force.
These charges are separated from each other in a way that reduces their potential energy.
These charges are on the surface of the conductor.
(The conductor might be hollow or solid).
A charged sphere shares charge equally with a neutral sphere of equal size when they are placed in contact with each other.

Conducting Sphere	*Hollow Sphere*	*Irregular Surface*
On a conducting sphere, the charge is evenly distributed around the surface.	*The charges on the hollow sphere are entirely on the outer surface.*	*On an irregular conducting surface, the charges are closest together at sharp points*
		

Lightning rods:

If an electric field is strong enough, when the particles hit other molecules, they will produce a stream of ions and electrons that form a plasma, which is a conductor.
The result is a spark or, in extreme cases, lightning.
To protect buildings from lightning, builders install lightning rods.
The electric field is strong near the pointed end of a lightning rod.
As a result, charges in the clouds spark to the rod, rather than to another point on the building. From the rod, a conductor takes the charges to the ground.
A lightning rod safely diverts lightning into the ground and away from the building.

Capacitors:
device for *storing electrical energy*. *consist of two conductors separated by an insulator.*

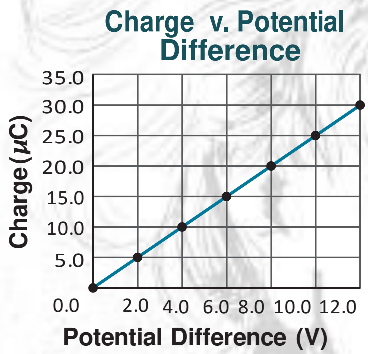
Capacitance:
Capacitance is the *ratio* *of the magnitude of the* *net charge on one plate of the capacitor to the potential difference across the plates.*

$$C = \frac{q}{\Delta V}$$

the work done to charge the capacitor

$$W = \frac{1}{2}C\Delta V^2 = \frac{1}{2}q\Delta V = \frac{1}{2}\frac{q^2}{c}$$

Were, q: a positive charge on one plate in coulombs.
Δv: potential difference between the two plates.
C: capacitance in $1F = 1\,C/V$
which called Farad (F)
1 F is a large capacitance.
Most capacitors used in *picofarads* $(10^{-12}\ F)$ *and microfarads* $(10^{-6}\ F)$



Data Table

Potential Difference (V)	Charge on a Plate (µC)
0.0	0.0
2.0	5.2
4.0	9.7
6.0	15.0
8.0	20.3
10.0	24.7
12.0	30.1

the potential difference results in a charge in each plate.
A graph of the data shows the relationship is linear.
The slope of this line is the capacitance of the capacitor.
the *area under* *the graph* *is work done* *to charge the capacitor*
Capacitor capacitance *depends* *on* *its geometrical dimensions*.

ثق انه ليس امامك خيار في هذه سوى التحدي

والتحدي يستلزم منك قوة ولا حول ولا قوة الا بالله

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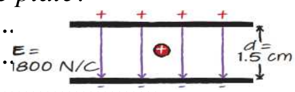
1. Two charged parallel plates are 1.5 cm apart. The magnitude of the electric field between the plates is 1800 N/C.

A. What is the electric potential difference between the plates?

B. How much work is required to move a proton from the negative plate to the positive plate?



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2. The electric field intensity between two large, charged, parallel metal plates is 6000 N/C. The plates are 0.05 m apart. What is the electric potential difference between them?

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3. A voltmeter reads 400 V across two charged, parallel plates that are 0.020 m apart. What is the electric field between them?

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4. What electric potential difference is applied to two metal plates that are 0.200 m apart if the electric field between them is $2.50x10^{3}$ N/C?

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5. When a potential difference of 125 V is applied to two parallel plates, the field between them is $4.25x10^{3}$ N/C. How far apart are the plates?

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6. A potential difference of 275 V is applied to two parallel plates that are 0.35 cm apart. What is the electric field between the plates?

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7. An oil drop weighs $1.9x10^{-15}$ N. It is suspended in an electric field of $6.0x10^{3}$ N/C. What is the charge on the drop? How many excess electrons does it carry?

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8. An oil drop carries one excess electron and weighs $6.4x10^{-15}$ N. What electric field strength is required to suspend the drop so it is motionless?

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9. A positively charged oil drop weighing $1.2x10^{-14}$ N is suspended between parallel plates separated by 0.64 cm. The potential difference between the plates is 240 V.

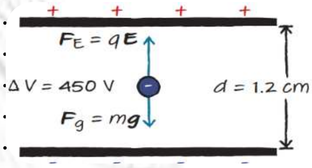
A. What is the charge on the drop?

B. How many electrons is the drop missing?

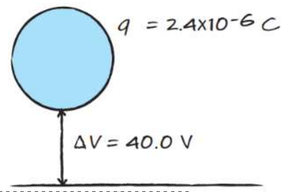
10. In a Millikan oil-drop experiment, a particular oil drop weighs 2.4×10^{-14} N. The parallel plates are separated by a distance of 1.2 cm. When the potential difference between the plates is 450 V, the drop is suspended.

a. What is the net charge on the oil drop?

b. If the upper plate is positive, how many excess electrons are on the oil drop?



11. A sphere was connected to the + pole of a 40-V battery while the – pole was connected to Earth. After a period of time, the sphere was charged to 2.4×10^{-6} C. What is the capacitance of the sphere-Earth system?



12. A 27 μF capacitor has an electric potential difference of 45 V across it. What is the amount the net charge on the positively charged plate of the capacitor?

13. Suppose you connect both a 3.3 μF and a 6.8 μF capacitor across a 24 V electric potential difference.

A. Which capacitor has the greater net charge on its positively charged plate?

B. what is its magnitude of the net charge?

14. You later find that the magnitude of net charge on each of the plates for each of the capacitors in the previous problem is 3.5×10^{-4} C.

A. Which capacitor has the larger potential difference across it?

B. What is that potential difference?

15. Suppose that you apply an electric potential difference of 6.0 V across a 2.2 μF capacitor. What does the magnitude of the net charge on one plate need to be to increase the electric potential difference to 15.0 V?

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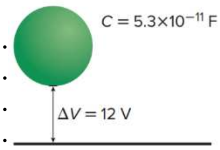
16. A sphere is charged by a 12 V battery and suspended above Earth as shown in Figure What is the net charge on the sphere?



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17. What is the magnitude of net charge on each conductor plate of a 0.47-μF capacitor when a potential difference of 12 V is applied across that capacitor?

....

18. What are the two properties that a test charge must have

....

19. How is the direction of an electric field defined?

....

20. Draw some of the electric field lines between each of the following:

A. two like charges of equal magnitude
B. two unlike charges of equal magnitude
C. a positive charge and a negative charge having twice the magnitude of the positive charge.
D. two oppositely charged parallel plates.

....

21. What is the electric field strength 20.0 cm from a point charge of 8.0×10^{-7} C?

....

22. The electric field in the atmosphere is about 150 N/C downward.

A. What is the direction of the force on a negatively charged particle?
B. Find the electric force on an electron with charge -1.602×10^{-19} C.
C. Compare the force in part b with the force of gravity on the same electron (mass = 9.1×10^{-31} kg).

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23. A force of 14.005 N exists on a positive test charge (q') that has a charge of 4.05×10^{-19}C. What is the magnitude of the electric field?

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24. A voltmeter indicates that the electric potential difference between two plates is 70.0 V. The plates are 0.020 m apart. What electric field intensity exists between them?

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25. A capacitor that is connected to a 45.0 V source has a charge of 90.0 μC.
What is the capacitor's capacitance?
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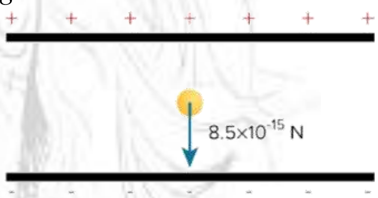
26. The oil drop shown in the diagram is negatively charged and weighs $4.5 \times 10^{-15}\ N$. The drop is suspended in an electric field intensity of $5.6 \times 10^{3} N/C$.



a. What is the charge on the drop?
b. How many excess electrons does it carry?

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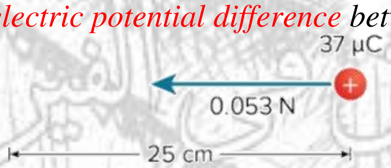
A force of 0.053 N is required to move a charge of 37μC a distance of 25 cm in a uniform electric field.
27. What is the size of the electric potential difference between the two points?



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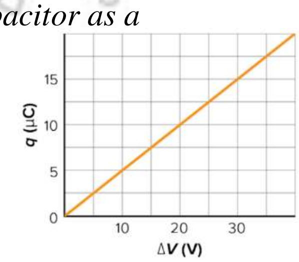
28. The graph represents the amount of charge stored on one plate of a capacitor as a function of the charging potential.

A. What does the slope of the line represent?
B. What is the capacitance of the capacitor?
C. What does the area under the graph line represent?



Choose correct answer:

1. As a positive test charge moves farther from a positive charge in an electric field, the potential energy

ⓐ increases ⓑ decreases ⓒ doubles ⓓ remains the same

2. The SI derived unit of potential difference is

ⓐ ohm ⓑ volt ⓒ joule ⓓ coulomb

3. Electric potential difference is measured in

ⓐ Newtons per coulomb ⓑ Coulombs per joule ⓒ Joules per coulomb ⓓ Volts per coulomb

4. What work is done when 3.5 C is moved through an electric potential difference of 4.5 V?

ⓐ $-16\ J$ ⓑ $16\ J$ ⓒ $7.8\ J$ ⓓ $-7.8\ J$

5. If $2.0 \times 10^2\ J$ of work are performed to move one coulomb of charge from a positive plate to a negative plate, what potential difference exists between the plates?

ⓐ $1.6 \times 10^{-19}\ V$ ⓑ $5.0 \times 10^{-3}\ V$ ⓒ $2.0 \times 10^3\ V$ ⓓ $2.0 \times 10^2\ V$

6. Which best describes electric potential difference?

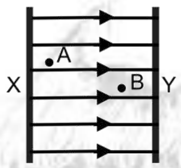
ⓐ the work needed to move a positive test charge between two points in an electric field divided by the magnitude of that test charge

ⓑ the magnitude of a positive test charge divided by the work needed to move the test charge between two points in an electric field

ⓒ the electrostatic force on a positive test charge divided by the magnitude of the test charge

ⓓ the magnitude of a positive test charge multiplied by the electrostatic force on that test charge

7. The figure below shows the electric field lines between two parallel plates X and Y. Which of the statements below are true?



ⓐ Electric potential at point A is greater than the electric potential at point B

ⓑ Electric field strength at point A is greater than the electric field strength at point B

ⓒ Plate Y is at a lower potential than plate X

ⓓ A and C

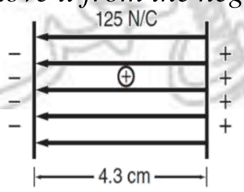
8. What is the potential difference between two plates that are 18 cm apart with a field of $4.8 \times 10^3\ N/C$?

ⓐ 27 V ⓑ 27 kV ⓒ 0.86 kV ⓓ 86 V

9. Two parallel plates are given opposite charges. A voltmeter measures the electric potential difference to be 47.0 V. The plates are 5.0 cm apart. What is the magnitude of the electric field between them?

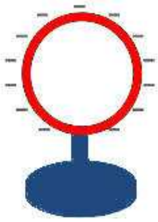
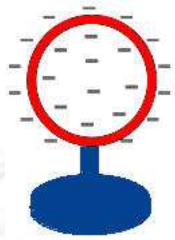
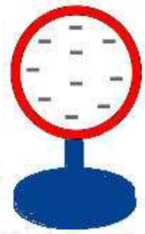
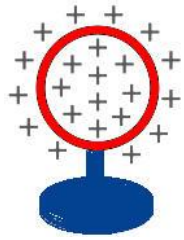
ⓐ $1.1 \times 10^{-3}\ N/C$ ⓑ $9.4 \times 10^3\ N/C$ ⓒ $9.4 \times 10^2\ N/C$ ⓓ $1.1 \times 10^{-2}\ N/C$

10. How much work done on a proton to move it from the negative plate to a positive plate 4.3cm away if the field is 125 N/C?



ⓐ $5.4\ J$ ⓑ $1.1 \times 10^{-16}\ J$ ⓒ $5.5 \times 10^{-23}\ J$ ⓓ $8.6 \times 10^{-19}\ J$

11. Which of the following shows the excess charge distribution on a hollow conductor?

ⓐ 
ⓑ 
ⓒ 
ⓓ 

12. A capacitor has a capacitance of 0.093 μF. If the charge of the capacitor is 58 μC, what is the electric potential difference?

ⓐ $5.4 \times 10^{-12}\ V$ ⓑ $1.6 \times 10^{-6}\ V$ ⓒ $6.2 \times 10^{2}\ V$ ⓓ $5.4 \times 10^{3}\ V$

13. Which of the following statements are true regarding the electric fields near a conductor?

ⓐ The field is always perpendicular to the surface of the conductor
ⓑ The potential difference between any two locations on the surface of the conductor is zero
ⓒ The surface of the conductor is equipotential
ⓓ All above

14. A 35μF capacitor has an electric potential difference of 50.0 V across it. What is the charge on the capacitor?

ⓐ $1.4 \times 10^{-6}\ C$ ⓑ $1.8 \times 10^{-3}\ C$ ⓒ $1.8 \times 10^{3}\ C$ ⓓ $1.75\ C$

15. When the electric potential difference between two positions in an electric field is zero, the positions are ________

ⓐ polar ⓑ in equilibrium ⓒ close together ⓓ at equipotential

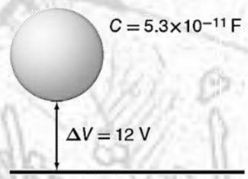
16. The function of a capacitor is to .

ⓐ measure capacitance
ⓑ store charges
ⓒ determine the charge on an object
ⓓ generate electric potential

17. What is the unit of capacitance?

ⓐ Farad ⓑ Joule/coulomb ⓒ Volt/coulomb ⓓ Coulomb

18. A sphere is charged by a 12 V battery and suspended above Earth as shown in the figure below. What is the net charge on the sphere?



ⓐ $3.7 \times 10^{-13}\ C$ ⓑ $2.3 \times 10^{11}\ C$ ⓒ $6.4 \times 10^{-10}\ C$ ⓓ $4.4 \times 10^{-12}\ C$

19. True or False?

A. If unlike charges are moved apart, the electric potential difference is positive.
B. The electric potential energy increases when the separation between two unlike charges increases.
C. The unit for electric field strength is N/C or V/m.
D. Charges on a conducting sphere spread far apart to minimize their potential energy.
E. If you move a constant positive charge through an increasing electric field, the amount of energy required to move it decreases
F. The electric field is always perpendicular to the surface of the conductor.
G. The surface of the conductor is equipotential.
H. The electric field inside a conductor is zero.

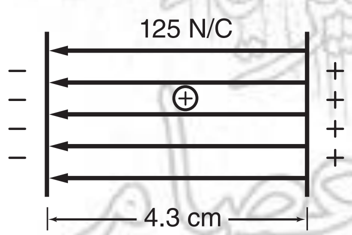
MULTIPLE CHOICE

1. Why is an electric field measured only by a small test charge?
   - **A.** so the charge doesn't disturb the field
   - **B.** because small charges have small momentum
   - **C.** so its size doesn't nudge the charge to be measured aside
   - **D.** because an electron always is used as the test charge and electrons are small

2. A positive test charge of 8.7 μC experiences a force of 8.1×10^{-6} N at an angle of 24° N of E. What are magnitude and direction of the electric field strength at the location of the test charge?
   - **A.** 7.0×10^{-8} N/C, 24° N of E
   - **B.** 1.7×10^{-6} N/C, 24° S of W
   - **C.** 1.1×10^{-3} N/C, 24° W of S
   - **D.** 9.3×10^{-1} N/C, 24° N of E

3. What is the potential difference between two plates that are 18 cm apart with a field of 4.8×10^{3} N/C?
   - **A.** 27 V
   - **B.** 86 V
   - **C.** 0.86 kV
   - **D.** 27 kV

4. How much work is done on a proton to move it from the negative plate to a positive plate 4.3 cm away if the field is 125 N/C?
   - **A.** 5.5×10^{-23} J
   - **B.** 8.6×10^{-19} J
   - **C.** 1.1×10^{-16} J
   - **D.** 5.4 J



5. How was the magnitude of the field in Millikan's oil-drop experiment determined?
   - **A.** using a measurable electromagnet
   - **B.** from the electric potential between the plates
   - **C.** from the magnitude of the charge
   - **D.** by an electrometer

6. In an oil drop experiment, a drop with a weight of 2.0×10^{-14} N was suspended motionless when the potential difference between the plates that were 63 mm apart was 0.78 kV. What was the charge of the drop?
   - **A.** -1.6×10^{-18} C
   - **B.** -4.0×10^{-16} C
   - **C.** -1.2×10^{-15} C
   - **D.** -9.3×10^{-13} C

7. A capacitor has a capacitance of 0.093 μF. If the charge of the capacitor is 58 μC, what is the electric potential difference?
   - **A.** 5.4×10^{-12} V
   - **B.** 1.6×10^{-6} V
   - **C.** 6.2×10^{2} V
   - **D.** 5.4×10^{3} V

FREE RESPONSE

8. Assume 18 extra electrons are on an oil drop. Calculate the charge of the oil drop, and calculate the potential difference needed to suspend it if it has a weight of 6.12×10^{-14} N and the plates are 14.1 mm apart.