GENERAL PHYSICS 2
2nd Semester - Module 2
ELECTRIC POTENTIAL

Name of Learner: ____________________________
Grade & Section: ____________________________
Name of School: ____________________________
General Physics 2 - Grade 12 (STEM)
Support Material for Independent Learning Engagement (SMILE)
Module 2: Electric Potential
First Edition, 2021

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What I Need to Know

This module will help you in understanding the basic concepts of electric potential and electric potential energy. At the end of this module, you should be able to:

1. Relate the electric potential with work, potential energy, and electric field. (STEM_GP12EM-IIIb-15);

2. Determine the electric potential function at any point due to highly symmetric continuous charge distributions (STEM_GP12EM-IIIc-17);

3. Infer the direction and strength of electric field vector, nature of the electric field sources, and electrostatic potential surfaces given the equipotential lines Define the work done by the electric force. (STEM_GP12EM-IIIc-18);

4. Calculate the electric field in the region given a mathematical function describing its potential in a region of space (STEM_GP12EM-IIIc-20); and

5. Solve problems involving electric potential energy and electric potentials (STEM_GP12EM-IIIc-22)

What's In

The concept of energy in General Physics 1 was useful in studying mechanics. The motion of the objects can be predicted by utilizing the law of conservation of energy. For instance, when you lift a book you are changing the gravitational potential energy. Lifting the object against the gravitational influence would mean doing work on the ball.

The concept of potential energy can also be associated with electrostatic behavior. This has been widely used in practical applications such as televisions, particle accelerators, circuits and particle accelerators.

In this module, the concepts of work and energy will be considered to electric fields. The work done in moving a test charge across the electric field allows the charge to gain electric potential energy. This is associated with another concept called electric potential.
Activity 1. Quick Check!

**Direction:** Let us check what you have learned about electric fields and charges in the previous lesson. Write T if the statement is correct; otherwise write F in the space provided.

___ 1. Electromagnetic force is associated with a fundamental property of matter - electric charge
___ 2. The SI unit of electric charge is the coulomb, symbol C.
___ 3. Electrostatic effects occur when electrical charges are separated.
___ 4. All charge separation involves the expenditure of energy.
___ 5. The magnitude of the electrostatic force between charges increases as their separation decreases.

What's New

**Activity 1: Membrane Potentials**

**Direction:** Study the structure of the cell membrane and the information provided about it. Then answer the activity questions that follow.

Living cells maintain a potential difference across their membrane. The potential difference is caused by disparities in terms of concentration and permeability of ions across the membrane. A membrane has an electrical charge due to the unequal concentrations of ions. The membrane potential is responsible for sending messages to the central nervous system.

The cell membrane’s lipid bilayer structure is important since its lipid-phosphorus head and fatty acid tail create a hydrophobic and hydrophilic character of the membrane. This houses the sodium and potassium ions pump, ATPase pump, ion transporters, and voltage-gated channels. It is also responsible for the regulation of ions getting in and out, which helps in determining the concentration of specific ions.

From the text, answer the following questions:

https://www.google.com/search?q=membrane+potential+infographic&tbm=isch&ved=2ahUKEwjgu4bP3IHvAhUSS5QKHdLxCsQQ2cCegQIABAA&oq=membrane+potential+infographic&gs_lcp=CgNpbWcQAzoECAAQE1CTiBNY7pUTYO2gE2gAcAB4AYABqgaIAZwmkgELMi0yLjMuMy4yLjGYAQCgAQGqAQtnd3Mtd2l6LWltZ8ABAQ&sclient=img&ei=U9s1YKDGCZKWOQQT86cogDAdhhiwB9khhwB8&#image=c3R5bGU6MDI2M
**Activity Questions:**

1. How would you define membrane potential?

_____________________________________________________________________________

_____________________________________________________________________________

2. What are the factors that could affect the ion movement?

_____________________________________________________________________________

_____________________________________________________________________________

3. If the membrane allows only positive charges to get through it, what happens to the concentration of both sides of the membrane?

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

4. From what you have learned in Biology, why is membrane potential essential among plants and animals?

_____________________________________________________________________________

_____________________________________________________________________________


**What Is It**

**Electric Potential Energy**

We can consider the potential energy of any charge using the gravitational analogy. Suppose you have a uniform electric field at the left with oppositely charged plates and Earth’s surface where gravitational field is also uniform.
This time, we place a test charge $q$ in the electric field and a body with mass $m$ in the gravitational field. Thus, the charge is now acted upon by an electric force and gravitational force.

\[
F_e = qE
\]

where $q$ is the charge and $E$ is the electric field

\[
F_g = ma_g
\]

where $m$ is the mass and $a_g$ is the acceleration due to gravity

If we want to move the test charge to plate B, a force must be applied to push against the force of the electric field. When a force $F$ is acted on a particle from points a to b, the work $W_{a\rightarrow b}$ done is given by a line integral.

\[
W_{a\rightarrow b} = \int_{a}^{b} Fdl = \int_{a}^{b} F\cos \phi \ dl
\]

where $dl$ is the infinitesimal displacement along the path and $\phi$ is the angle between the force and displacement along the path. If the force applied is conservative, the work done can be expressed as potential energy $U$. Thus,

\[
W_{a\rightarrow b} = U_a - U_b = -(U_b - U_a) = -\Delta U
\]

If $W_{a\rightarrow b}$ is positive, $U_a$ is greater than $U_b$, $\Delta U$ is negative, potential energy decreases. For instance, when mass $m$ falls towards the Earth's surface, gravity does positive work, but the gravitational potential energy decreases. If the mass was tossed upward, the gravity does negative work and potential energy increases.

Whether the test charge in the electric field is positive or negative, the potential energy increases if the test charge moves opposite to the direction of the electric force. Potential energy decreases if the charge moves in the same direction as the electric force. Similarly, the gravitational potential energy increases if the body moves upward or against the direction of gravitational force and decreases if it moves downward or in same direction with gravitational force.
Electric Potential Energy of Two Point Charges

The electric potential energy between two point charges is given as:

\[ U = \frac{1}{4\pi \varepsilon_0} \frac{qq_0}{r} \]

where \( r \) is the distance of separation, \( qq_0 \) are the values of 2 charges. The electric potential energy is expressed as Nm or Joules (J).

For electric potential energy with several test charges, this is expressed as:

\[ U = \frac{q_0}{4\pi \varepsilon_0} \left( \frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} + \ldots \right) = \frac{q_0}{4\pi \varepsilon_0} \sum_i \frac{q_i}{r_i} \]

Example 1:
A point charge \( q_1 = +2.80 \mu\text{C} \) is at origin. How far should the second point charge of \( +5.20 \mu\text{C} \) be placed to have electric potential energy of \( 0.600 \text{ J} \)?

<table>
<thead>
<tr>
<th>A</th>
<th>What is/are given?</th>
<th>( Q_1 = +2.80 \times 10^{-9} \text{ C} ) ( Q_2 = +5.20 \times 10^{-6} \text{ C} ) ( U = 0.600 \text{ J} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>What is asked?</td>
<td>( r = ? )</td>
</tr>
<tr>
<td>C</td>
<td>Are the units consistent with the formula?</td>
<td>Yes</td>
</tr>
<tr>
<td>D</td>
<td>How will you draw the problem?</td>
<td>[Diagram showing two charges and a line representing the distance ( r )]</td>
</tr>
<tr>
<td>E</td>
<td>What strategy must be employed?</td>
<td>We rearrange the formula and solve for ( r ) since it is unknown. Then, we plug-in the values.</td>
</tr>
<tr>
<td>F</td>
<td>Solution</td>
<td>[ r = \frac{1}{4\pi \varepsilon_0} \frac{qq_0}{U} = \frac{1}{4\pi \varepsilon_0} \frac{(2.80 \times 10^{-6} \text{C})(5.20 \times 10^{-6} \text{C})}{0.600 \text{J}} = 9 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2} \frac{1.456 \times 10^{-11} \text{C}^2}{0.600 \text{ Nm}} = 0.2184 \text{ m} ]</td>
</tr>
<tr>
<td>G</td>
<td>What is the conclusion?</td>
<td>Therefore, the second charge must be placed 0.2184 m from charge 1</td>
</tr>
</tbody>
</table>
**Example 2:**
A charge of $4.50 \times 10^{-8}$ C is placed in a uniform electric field that is directed vertically upward with a magnitude of $5.00 \times 10^4$ N/C. What work is done by the electrical force when the charge moves 0.450 m to the right? 0.800 m downward? 2.60 m at an angle of 45 degrees from the horizontal?

<table>
<thead>
<tr>
<th></th>
<th>What is/are given?</th>
<th>Q = $+4.50 \times 10^{-8}$ C</th>
<th>$E = 5.00 \times 10^4$ N/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$r = 0.450$ m, $r = 0.800$ m and $r = 2.60$ m, 45°</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>What is asked?</th>
<th>W = ?</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Are the units consistent with the formula?</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>How will you draw the problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>What strategy must be employed?</th>
<th>We can use $W = Fd \cos \theta$, where $F = qE$.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

$$W = Fd = qEd = (4.50 \times 10^{-8} \text{C}) \left(5.00 \times \frac{10^4 \text{N}}{\text{C}} \right)(0.45 \text{ m} \cos 90) = 0 \text{J}$$

$$W = Fd = qEd = (4.50 \times 10^{-8} \text{C}) \left(5.00 \times \frac{10^4 \text{N}}{\text{C}} \right)(0.800 \text{ m} \cos 0) = -1.8 \times 10^{-3} \text{J}$$

since the movement of the charge is opposite the direction of electric field

$$W = Fd = qEd = (4.50 \times 10^{-8} \text{C}) \left(5.00 \times \frac{10^4 \text{N}}{\text{C}} \right)2.60 \text{ m} \cos 45 = 4.137 \times 10^{-3} \text{J}$$

<table>
<thead>
<tr>
<th></th>
<th>What is the conclusion?</th>
<th>Therefore, the work done when the charge is move to the right is 0 J. When it moved downwards, it has done $-1.8 \times 10^{-3}$ J. Finally, when it is moved 2.60 m at an angle of 45 degrees, it has done work at 4.137 J</th>
</tr>
</thead>
</table>
**Electric Potential**

The potential energy was associated with a test charge in an electric field. This time, we will be expressing the potential energy per unit charge leading us to another concept known as electric potential or simply potential. Potential is expressed as:

\[ V = \frac{U}{q_0} \]

where \( U \) is the electric potential energy and \( q_0 \) is the charge. The electric potential is expressed as volt (V).

1 Volt = 1 Joule/Coulomb

When we divide both sides of the equation relating work done by the electric force from points a to b by \( q_0 \) to represent it as work per unit charge.

\[
\frac{W_{a\rightarrow b}}{q_0} = -\frac{\Delta U}{q_0} = -\left(\frac{U_b}{q_0} - \frac{U_a}{q_0}\right) = -(V_b - V_a) = V_a - V_b
\]

The difference \( V_a - V_b \) is known as the potential difference. It is the difference between the potential at point a and point b. This will be analyzed more in electric circuits.

| To find the electric potential \( V \) of a single point charge, we can express this as | \( V = \frac{1}{4\pi\varepsilon_0} \frac{q}{r} \) | 1. The potential at any point is negative if \( q \) is negative.  
2. The potential at any point is positive if \( q \) is positive.  
3. The potential is zero at \( r = \infty \) |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>To find the electric potential ( V ) of a several point charges, we can express this as</td>
<td>( V = \frac{1}{4\pi\varepsilon_0} \sum_i \frac{q_i}{r_i} )</td>
<td>It is the scalar sum of the fields produced by each charge</td>
</tr>
</tbody>
</table>
| In case there is a continuous distribution of charges along a line, over a surface or through the volume, the charge is divided into elements and the sum becomes an integral | \( V = \frac{1}{4\pi\varepsilon_0} \int \frac{dq}{r} \) | \( dq = \lambda dl \) (linear)  
\( dq = \sigma dA \) (surface)  
\( dq = \rho dV \) (volume) |
**Example 3:**
A point charge has a charge of $8.00 \times 10^{-11}$ C. At what distance from the point charge is the electrical potential (a) 12.0 V? (b) 24.0 V?

|   | What is/are given? | $Q_1 = 8.00 \times 10^{-11}$ C  
$V_1 = 12.0$ V; $V_2 = 24.0$ V |
<table>
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<th></th>
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</thead>
<tbody>
<tr>
<td>B</td>
<td>What is asked?</td>
<td>$r = ?$</td>
</tr>
<tr>
<td>C</td>
<td>Are the units consistent with the formula?</td>
<td>Yes</td>
</tr>
</tbody>
</table>
| D | How will you draw the problem? | $8.00 \times 10^{-11}$  
\[ \begin{array}{ccc}
+ & 24 \text{ V} & 12 \text{ V} \\
\end{array} \] |
| E | What strategy must be employed? | We rearrange the formula and solve for $r$ since it is unknown. Then, we plug-in the values. |
| F | Solution | 
\[
r = \frac{1}{4\pi \varepsilon_0} \frac{q}{V} = \frac{1}{4\pi \varepsilon_0} \frac{8.00 \times 10^{-11} \text{ C}}{24 \text{ V}} = 9 \times 10^9 \frac{N m^2}{C^2} \left(3.33 \times 10^{-12} \frac{C}{J/C} \right) \\
= 9 \times 10^9 \frac{N m^2}{C^2} \left(3.33 \times 10^{-12} \frac{C}{N m/C} \right) = 0.03 \text{ m} \\
\]
\[
\text{at 12 V} \\
r = \frac{1}{4\pi \varepsilon_0} \frac{q}{V} = \frac{1}{4\pi \varepsilon_0} \frac{8.00 \times 10^{-11} \text{ C}}{12 \text{ V}} = 9 \times 10^9 \frac{N m^2}{C^2} \left(6.67 \times 10^{-12} \frac{C}{J/C} \right) \\
= 9 \times 10^9 \frac{N m^2}{C^2} \left(6.67 \times 10^{-12} \frac{C}{N m/C} \right) = 0.06 \text{ m} \\
\]
| G | What is the conclusion? | Therefore, at 0.03 m the electric potential is 24 V while at 0.06 m, the electric potential is 12 V. Moving to the same direction of electric field would yield decreasing potential values. On the other hand, when $r$ approaches infinity, the potential becomes zero. |
**Electric Potential from an Electric Field**

Determining electric potential from electric field is given by:

\[
V_a - V_b = \int_a^b E \, dl = \int_a^b E \cos \phi \, dl = -\int_a^b E \, dl
\]

Hence, 

\[
E = \frac{V}{d}
\]

where electric field can be expressed as Volt/meter or Newton/Coulomb.

If you move in the direction of electric potential, the electric potential \( V \) decreases. It increases when you move in the direction opposite to the electric field.

---

**Electron Volts**

If charge \( q \) is the magnitude of the electron charge and the potential difference is \( 1 \) V, the change in energy in moving the charge from points a to point is \( 1.602 \times 10^{-19} \) J. This quantity of energy is defined to be 1 electron volt (eV)

\[
1 \text{ eV} = 1.602 \times 10^{-19} \text{J}
\]

**Equipotential Surfaces**

Topographic maps are represented by contour lines drawn through points with similar elevation. These contour lines represent the curves of constant gravitational potential energy. When they are very close to each other, the terrain is steep, and large elevation changes occur. If these are far apart, the terrain is gently sloping.

In analogy, an equipotential surface is a three-dimensional surface where electric potential \( V \) is the same. If a test charge is moved from one point to another point on a given surface, the electric potential remains the same.
The equipotential surfaces are always perpendicular to the electric field lines. There is no work when a charge is moved from point to point b within the same equipotential surface. When charges are at rest, the conductor’s surface is an equipotential surface. Electric fields are always directed perpendicular to the surface. This also holds true for charges at rest in an entire solid volume of a conductor.

**What's More**

**Activity 2: Qualitative Problems**

**Direction:** Answer the following questions.

(1) The potential energy of a certain system of two charges increases as the charges are moved farther apart. What does this tell us about the sign of the charges? Why?

____________________________________________________________________________________

____________________________________________________________________________________

(2) Show that volt per meter is the same as newton per coulomb.

____________________________________________________________________________________

____________________________________________________________________________________

(3) A student said “electric potential is always proportional to potential energy; why bother with the concept of potential at all? How would you respond?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
Activity 3: Quantitative Problem

Direction: Solve the problems and write your answers on a separate sheet of paper. You may also consult your Physics teacher.

An electric dipole consists of point charges, $q_1 = +12 \text{ nC}$ and $q_2 = -12 \text{ nC}$ placed 10.0 cm apart. Compute the electric potentials at points a, b and c.

Hint: *use the electric potentials for several point charges*

Scoring Rubric

<table>
<thead>
<tr>
<th>Criteria</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics Approach</td>
<td>The approach is appropriate and complete</td>
<td>The approach contains minor errors</td>
<td>Some of the concepts and principles are missing or inappropriate</td>
<td>The solution doesn't indicate an approach</td>
</tr>
<tr>
<td>Procedure</td>
<td>Mathematical and logical procedures are clear, complete and connected</td>
<td>Mathematical and logical procedures are missing/contain errors</td>
<td>Most of the mathematical and logical procedures</td>
<td>All procedures are incomplete and contain errors</td>
</tr>
<tr>
<td>Description</td>
<td>Diagrams and symbols used are appropriate and complete</td>
<td>Parts of the diagrams and symbols contain errors</td>
<td>Most of the parts of the diagrams and symbols are not useful</td>
<td>The entire visualization is wrong or did not include visualization.</td>
</tr>
</tbody>
</table>
What I Can Do

Activity 4. Building Concept Map
Direction: Create a concept map out from the things you have learned from this module. You can use words, terms, phrases, or formulas in connecting these concepts. Refer to the scoring guide below:

<table>
<thead>
<tr>
<th>Legible (easy to read)</th>
<th>No (0-1)</th>
<th>Yes (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate (concepts were used accurately)</td>
<td>Many inaccuracies (0-2)</td>
<td>A few inaccuracies (3-4)</td>
</tr>
<tr>
<td>Complete (sufficient number of relevant concepts and relationships)</td>
<td>Limited use of concepts (0-2)</td>
<td>Some use of concepts (3-4)</td>
</tr>
<tr>
<td>Sophisticated (finding meaningful connections between relevant concepts)</td>
<td>Little or none (0-1)</td>
<td>Few meaningful connections made (2-4)</td>
</tr>
</tbody>
</table>

Mueller's Classroom Concept Rubric

Assessment

Directions: Write the letter of your choice in the space provided.

For Nos. 1-2, refer to this problem: Four positive charges of equal magnitude were placed in each corner of a square.

_____ 1. What will be the electric potential at the center of the square?
   a. zero  b. \(4k \frac{q}{r}\)  c. \(8\sqrt{2}k \frac{q}{r}\)  d. \(4\sqrt{2}k \frac{q}{r}\)

_____ 2. What will be the electric potential at the center of the square if two charges at the top are replaced with negative charges?
   a. zero  b. \(4k \frac{q}{r}\)  c. \(8\sqrt{2}k \frac{q}{r}\)  d. \(4\sqrt{2}k \frac{q}{r}\)
3. If the distance between two charges is quadrupled, how would the electric potential energy change?
   a. doubled  b. halved  c. quadrupled  d. quartered

For Nos. 4-8 refer to the diagram at the right.

4. What is the direction of the electric field at point B?
   a. upward  c. right  b. downward  d. left

5. What is the direction of the electric field at point A?
   a. upward  b. downward  c. right  d. left

6. Suppose a positive charge was moved from points A to B. What is work done along the path?
   a. increasing  c. zero  b. decreasing information  d. incomplete

7. Suppose a negative charge was moved from points A to B. What is work done along the path?
   a. increasing  c. zero  b. decreasing information  d. incomplete

8. At which point is the electric field does zero work on a test charge?

9. At which point has higher potential?

10. At which point is the electric field strongest?

11. What is the change in potential energy when a +3.5 C point charge was moved from a negative plate to a positive plate with a potential difference of 8V?
    a. 28 J  b. 0.4375 J  c. 2.29 J  d. 0 J

12. What is the magnitude of the electric field between parallel plates with 25 V of potential difference and placed 25 cm apart?
    a. 1 N/m  b. 1 V/C  c. 1 N/C  d. 1 N/m/C

13. What is the electric potential at point A when q₁ = -20 μC and q₂ = +20 μC?
    a. 8.0 μC  b. 1.9 μC  c. 5.5 μC  d. 2.4 μC
14. Which of the following are valid units for electric field?
   I. N/C   II. J/Cm   III. V/m
   a. I and II only  b. II and III only  c. I and III only  d. I, II and III

15. How much work is needed to decrease the distance between a +15 µC charge and a -20 µC charge from 1 m to 0.25 m?
   a. -8.1 J  b. 8.1 J  c. 2.7 J  d. -2.7 J

Additional Activities

Activity 5. Social Context

The community is a rich source of learning opportunities of electric potential. Choose one from the following suggested activities in understanding the importance and utilization of electric potential in our daily lives:

1. In a certain region an electric potential V is present. An unknown charge Q is moved around this region between points at potential difference ΔV. A physicist measures the change in the potential energy ΔU as the charge is moved. The table below shows the data of the measurements. The unit for ΔV are MV (mega-Volts), the units for ΔU are kJ (kilo-joules).

   | ΔV   | 57.1 | 29.9 | 16.7 | 9.97 | 8.55 | 8.32 | 6.52 | 6.87 |
   | ΔU   | 362.8| 157.6| 124.3| 55.3 | 48.8 | 53.9 | 37.9 | 47.3 |

   You want to find the value of the unknown charge Q in mC. Since ΔU = QΔV make the plot \( y = mx \) where \( y = \Delta U \) and \( x = \Delta V \). Use Excel, calculator, or whatever you prefer. From the slope of the plot, calculate Q.

2. Suppose a friend asks you to explain how electric potential relates to potential energy. Write a brief explanation that you could use to explain this concept to a friend who does not understand the relationship between two concepts.

3. Conduct simulations on electrostatics, electric fields, Gauss's law using online sources. From this, write a short reflection. Refer to any sites below:
   https://www.edumedia-sciences.com/en/node/81-electric-potential
   https://ophysics.com/em4.html
Activity 1 From 1 to 5 the answer is TRUE

Activity 2 Membrane Potentials
1. It is the difference of concentrations of ions within the membrane’s region
2. Ion concentrations, like charges repel and unlike charges attract, permeability
3. The other side of the membrane becomes negatively charged while the other side becomes positively charged
4. Electron transport chain necessary for ATP production

Activity 3
1. They have opposite signs. Justifications may vary.
2. \( \text{V/m} = \text{N/C} \)
   \( \text{I/C/m} = \text{N/C} \)
   \( \text{kgm}^2/\text{s}^2/\text{C/m} = \text{N/C} \)
   \( \text{kgm}^2/\text{s}^2/\text{C} = \text{kgm/s}^2/\text{C} \)
3. Electric potential is expressed as volts while electric potential energy is expressed as Joules

Activity 4
\[ a = -900 \text{V}; \ b = 1930 \text{V}; \ c = 0 \text{V} \]

ASSESSMENT
1. B 6. D 11. A
The diagram shows the electric field in the vicinity of a .... https://www.answersmine.com/the-diagram-shows-the-electric-field-in-the-vicinity-of-a-charge-at-which-point-is-the-electric-field-strongest-a-w-b-x-c-y-d-z-3076706/
What is the change in potential energy when a 12 N book is .... https://www.enotes.com/homework-help/what-was-change-potential-energy-system-258247

Electric Potential | University Physics with Mode....
https://www.numerade.com/books/chapter/electric-potential/

Which of the following are valid units for the rate of a ....
https://au.answers.yahoo.com/question/index?qid=20080810201614AAHE68l


Answered: In a certain region an electric... | bartleby. https://www.bartleby.com/questions-and-answers/in-a-certain-region-an-electric-potential-v-is-present.-an-unknown-charge-q-is-moved-around-this-reg/9f2dc11b-c712-4097-bdeb-4b58a09c6bb4

ELECTRIC POTENTIAL SIMULATION.
https://pages.physics.ua.edu/lab10x/2em/SIM/Potential_SIM.pdf

Region IX: Zamboanga Peninsula Hymn – Our Eden Land

Here the trees and flowers bloom
Here the breezes gently Blow,
Here the birds sing Merrily,
The liberty forever Stays,
Here the Badjaos roam the seas
Here the Samalis live in peace
Here the Tausogs thrive so free
With the Yakans in unity

Gallant men And Ladies fair
Linger with love and care
Golden beams of sunrise and sunset
Are visions you’ll never forget
Oh! That’s Region IX

Hardworking people Abound,
Every valleys and Dale
Zamboangueños, Tagalogs, Bicolanos,

Cebuanos, Ilocanos, Subanons, Boholanos, Ilongos,
All of them are proud and true
Region IX our Eden Land
Region IX
Our...
Eden...
Land...

My Final Farewell

Farewell, dear Fatherland, clime of the sun caress’d
Pearl of the Orient seas, our Eden lost!,
Glady now I go to give thee this faded life’s best,
And were it brighter, fresher, or more blest
Still would I give it thee, nor count the cost.

On the field of battle, ‘mid the frenzy of flight,
Others have given their lives, without doubt or heed;
The place matters not-cypress or laurel or lily white,
Scaffold or open plain, combat or martyrdom’s plight,
T is ever the same, to serve our home and country’s need.

I die just when I see the dawn break,
Through the gloom of night, to herald the day;
And if color is lacking my blood thou shalt take,
Poured out at need for thy dear sake
To dye with its crimson the waking ray.

My dreams, when life first opened to me,
My dreams, when the hopes of youth beat high,
Were to see thy lov’d face, O gem of the Orient sea
From gloom and grief, from care and sorrow free;
No blush on thy brow, no tear in thine eye.

If ever my grave some day thou seest grow,
In the grassy sod, a humble flower,
Draw it to thy lips and kiss my soul so,
Beloved creatures all, farewell! In death there is rest!
Let the sun draw the vapors up to the sky,
And heavenward in purity bear my tardy protest
Let some kind soul o’er my untimely fate sigh,
And in the still evening a prayer be lifted on high
From thee, 0 my country, that in God I may rest.

And when the dark night wraps the graveyard around
With only the dead in their vigil to see
Break not my repose or the mystery profound
And perchance thou mayest hear a sad hymn resound
’T is I, O my country, raising a song unto thee.

And even my grave is remembered no more
Unmarked by never a cross nor a stone
Let the plow sweep through it, the spade turn it o’er
That my ashes may carpet earthly floor,
Before into nothingness at last they are blown.

Then will oblivion bring to me no care
As over thy vales and plains I sweep;
Throbbed and cleansed in thy space and air
With color and light, with song and lament I fare,
Ever repeating the faith that I keep.

My Fatherland ador’d, that sadness to my sorrow lends
Beloved Filipinas, hear now my last good-bye!
I give thee all: parents and kindred and friends
For I go where no slave before the oppressor bends,
Where faith can never kill, and God reigns e’er on high!
Farewell to you all, from my soul torn away,
Farewell to thee, too, sweet friend that lightened my way;
Beloved creatures all, farewell! In death there is rest!

I am a Filipino, by Carlos P. Romulo

I am a Filipino–inheritor of a glorious past, hostage to the uncertain future. As such I must prove equal to a two-fold task—the task of meeting my responsibility to the past, and the task of performing my obligation to the future.

I sprung from a hardy race, child many generations removed of ancient Malayon pioneers. Across the centuries the memory comes rushing back to me: of brown-skinned men putting out to sea in ships that were as frail as their hearts were stout. Over the sea I see them come, borne upon the billowing wave and the whistling wind, carried upon the mighty swell of hope—hope in the free abundance of new land that was to be their home and their children’s forever.

I am a Filipino. In my blood runs the immortal seed of heroes—seed that flowered down the centuries in deeds of courage and defiance. In my veins yet pulses the same hot blood that sent Lapulapu to battle against the first invader of this land, that served Lakandula in the combat against the alien foe, that drove Diego Silang and Dagohoy into rebellion against the foreign oppressor.

The seed I bear within me is an immortal seed. It is the mark of my manhood, the symbol of dignity as a human being. Like the seeds that were once buried in the tomb of Tutankhamen many thousand years ago, it shall grow and flower and bear fruit again. It is the insignia of my race, and my generation is but a stage in the unending search of my people for freedom and happiness.

I am a Filipino, child of the marriage of the East and the West. The East, with its languor and mysticism, its passivity and endurance, was my mother, and my sire was the West that came thundering across the seas with the Cross and Sword and the Machine. I am of the East, an eager participant in its spirit, and in its struggles for liberation from the imperialist yoke. But I also know that the East must awake from its centuried sleep, shake off the lethargy that has bound his limbs, and start moving where destiny awaits.

I am a Filipino, and this is my inheritance. What pledge shall I give that I may prove worthy of my inheritance? I shall give the pledge that has come ringing down the corridors of the centuries, and it shall be compounded of the joyous cries of my Malayon forebears when first they saw the contours of this land loom before their eyes, of the battle cries that have resounded in every field of combat from Mactan to Tirad Pass, of the voices of my people when they sing:

“I am a Filipino born to freedom, and I shall not rest until freedom shall have been added unto my inheritance—for myself and my children and my children’s children—forever.”