آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

# Pacing Guide for Teachers

# PHYSICS

## Grade X

## Theory



Number of weeks: 28

Number of periods per week: 4

Key Textbook: Punjab Curriculum and Textbook Board Grade X Physics

Teacher Developer(s): Rafana Saif

Institution(s): Al-Murtaza School, Karachi

## Topic Total Periods

10. Simple Harmonic Motion and Waves 12

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 10.2 Waves, their nature and types | 10.2.1-10.2.2 | 2 |
| | 10.2.3-10.2.4 | 2 |
| 10.4 Characteristic of Waves | 10.4.1 | 1 |
| | 10.4.2-10.4.3 | 2 |
| 10.3 Properties of Waves | 10.3.1 | 1 |
| 10.1 Simple Harmonic Motion (SHM) | 10.1.1-10.1.2 | 1 |
| | 10.1.3-10.1 4 | 1 |
| | 10.1.5-10.1.6 | 2 |



## Learning Resources

- Physics for Class X Sindh Textbook Board
- Physics (GCE 'O' levels) by Dr Charles Chew, Leong See Cheng and Chow Sien Foong
- Physics Matter by Nick England

# Web Resources

https://www.youtube.com/watch?v=btNvr8KAQyM

https://www.youtube.com/watch?v=CVsdXKO9xlk

https://www.youtube.com/watch?v=1bHipDSHVG4

https://www.youtube.com/watch?v=tudxily5Qu0

# Suggested Activities and/or Formative Assessment

## Activity 1:

Show student videos given in the web resource section and ask them to note the important points in the video. Then rerun the videos and put different questions by stopping videos at certain point.

## Activity 2

Provide students with slinkiest, ropes, or springs and explore how waves transfer energy. Set up different scenarios, such as dropping pebbles into a container of water, creating waves, and observing how the energy is transferred through the water. Discuss the connection between wave amplitude and energy transfer.

## Activity 3

Begin by discussing the concept of waves and explaining that there are two main types: mechanical waves and electromagnetic waves. Emphasis that while both types involve the transfer of energy, they have distinct characteristics. Divide the class into groups and provide each group with a slinky (or rope) and a flashlight (or laser pointer).

**Mechanical Wave Demonstration**

- Each group should stretch the slinky or rope along a table or the floor. One person at a time should create a mechanical wave by quickly moving their hand back and forth at one end of the slinky.
- Other group members should observe and describe characteristics, such as amplitude, wavelength, and how it travels. Electromagnetic Wave Demonstration:
- Each group should darken the room or find a darker area.
- One person at a time should shine the flashlight or laser pointer on a flat surface (e.g., a wall) and wiggle it slightly to create an oscillating beam of light. Other group members should observe and describe the characteristics of the electromagnetic wave, such as the color, intensity, and how it appears to propagate.

Group Discussions: Bring the groups together for a discussion. Ask them to compare and contrast the observations made during the mechanical wave and electromagnetic wave demonstrations.

## Activity 4

Provide students with slinkiest, ropes, or springs, and ask them to measure and compare properties like wavelength, amplitude, and frequency. They can calculate wave speed using the equation $v = f \lambda$ and analyze the relationships between these properties.

## Activity 5

Set up a ripple tank and let students observe and investigate the properties of water waves. They can explore concepts such as wave reflection, refraction, interference, and diffraction by using different obstacles and barriers in the tank. Ask them to make a note of observation and encourage them to draw the wave pattern for each wave emphasising wavelength and direction of motion.

## Activity 6

### Pendulum Experiment

Set up a pendulum using a string and a weight (such as a small ball or a bob). Measure the length of the string and the time it takes for the pendulum to complete one full swing. Vary the length of the string and observe how it affects the period of the pendulum. Plot a graph of length versus period and discuss the relationship between the two.

### Mass-Spring System

Attach a spring to a wall or a rigid support and hang a mass (such as a weight or a small object) from the spring. Measure the displacement of the mass from its equilibrium position and observe how it oscillates back and forth. Vary the mass or the spring constant and observe the changes in the period and amplitude of the oscillation.

### Damped Oscillations

Explore the effect of damping on simple harmonic motion. Introduce a damping force to a pendulum or a mass-spring system (e.g., by adding air resistance or friction). Observe how damping affects the amplitude and period of the oscillation over time. Discuss the concept of damping and its implications in real-life systems.

## Activity 7

https://www.psd1.org/cms/lib/WA01001055/Centricity/Domain/1674/5EvaluationPropertiesofWavesAssessment-1502753477508.pdf

## Activity 8

Ask students to write how does each wave type originate? Mechanical waves require a medium (such as the slinky or rope) for propagation, while electromagnetic waves can travel through a vacuum (like light from a flashlight).

## Activity 9

Give students different scenarios to draw the wave pattern and write for each wave behavior with respect to frequency, wavelength, speed and direction of motion.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

## Topic — Total Periods

11. Sound — 7

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 11.1 Sound Waves | 11.1.1-11.1.2 | 1 |
| 11.2 Characteristic of Sound | 11.2.1-11.2.2 | 1 |
| | 11.2.3-11.2.5 | 2 |
| 11.3 Noise Pollution | 11.3.1-11.3.2 | 1 |
| | 11.3.3 | 1 |
| 11.4 Audible Frequency Range | 11.4.1-11.4.2 | 1 |



## Learning Resources

- Physics Matter by Nick England
- Comprehensive Physics for 'O' Level Science by Charles Chew and Leong See Cheng

## Web Resources

https://www.youtube.com/watch?v=OaAEdV7ZIZU&list=RDLVlBYmH4iz3eY&index=11

https://www.youtube.com/watch?v=GuvYffYISJc

# Suggested Activities and/or Formative Assessment

## Activity 1

- Place the ruler or metal spoon on the edge of a table or desk, leaving a portion hanging freely off the edge. Secure the ruler or spoon to the table using a rubber band or tape so that it stays in place.
- Take the small object (bead or paperclip) and gently tap it against the hanging portion of the ruler or spoon.
- Observe and listen to the sound produced.

## Activity 2

### Pitch and Frequency

Investigate the relationship between pitch and frequency of sound waves. Use a tuning fork or a musical instrument (such as a guitar or piano) to produce different pitches. Use a frequency analyzer app or a sound sensor connected to a computer to measure the frequencies of the sounds. Plot a graph of pitch (low to high) versus frequency (in Hz) and discuss the relationship between the two.

### Sound Waves and Distance

Explore how distance affects the intensity of sound waves. Set up a sound source (such as a speaker) and a sound sensor at a fixed distance. Play a constant tone or sound and measure the intensity of the sound using a sound level meter or a smartphone app. Move the sound sensor closer or farther away from the source and observe how the intensity changes with distance.

## Activity 3

- Provide students with sound level meters or sound level meter apps on their smartphones.
- Instruct them to walk around their assigned area and measure the noise levels at various locations.
- Ask students to record the noise levels and make note of any specific sources of noise they encounter.
- Back in the classroom, have them create a noise map of their assigned area, indicating areas with high and low noise levels. Discuss the findings as a class, identifying common sources of noise pollution and potential strategies to reduce noise in specific areas.

### Echo Chamber Design:

Provide students with a set of materials, such as cardboard, tape, and rubber bands. Instruct them to design and build their own echo chamber. Encourage them to experiment with different shapes, sizes, and materials to enhance the echo effect. Once the echo chambers are built, each group takes turns testing their creations by making sounds inside the chambers and observing the echo. Discuss the design choices that led to the most effective echo chambers and the science behind the phenomenon.

Provide students with different types of materials and ask them to make soundproof chambers further explaining to them the effects of different materials in acoustic protection.

### Acceleration

Students can explore acceleration by experimenting with different objects and how they accelerate. For example, they can drop objects of different sizes and weights from the same height and observe how they accelerate differently due to their mass and air resistance.

## Activity 4

Play different sounds at different frequencies and ask students to note their findings at the end of the activity and discuss how were the sounds at different levels and which frequencies they were able to hear.

## Activity 5

### Discussion points and follow-up questions

**Teacher can perform discussion based on the following questions.**

- What did you observe when you tap a ruler or spoon?
- What do you think caused the sound to be produced?
- How would the sound change if you tapped the ruler or spoon harder or softer?
- Try changing the length of the hanging portion of the ruler or spoon. How does it affect the sound produced?
- Can you explain why the ruler or spoon produces sound when tapped?

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

[https://akueb.knowledgeplatform.com/login](https://akueb.knowledgeplatform.com/login)

**Topic** **Total Periods**

12. Geometrical Optics 25

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 12.1 Reflection of light | 12.1.1-12.1.2 | 1 |
| 12.2 Image Location by Spherical Mirror-Equation | 12.2.1 | 2 |
| 12.3 Refraction of light | 12.3.1-12.3.2 | 1 |
| | 12.3.3 | 2 |
| | 12.3.4 | 2 |
| | 12.3.5 | 1 |
| 12.4 Total Internal Reflection | 12.4.1-12.4.2 | 1 |
| | 12.4.3-12.4.5 | 1 |
| 12.5 Image location by Lens Equation | 12.5.1-12.5.2 | 2 |

| | | |
|---|---|---|
| | 12.5.3 | 2 |
| 12.6 Magnifying Power and Resolving Power | 12.6.1-12.6.2 | 1 |
| 12.7 Compound Microscope | 12.7.1-12.7.2 | 1 |
| | 12.7.3-12.7.4 | 1 |
| | 12.7.5-12.7.6 | 2 |
| 12.8 Telescope | 12.8.1-12.8.2 | 2 |
| 12.9 Defects in Human Eye | 12.9.1-12.9.2 | 2 |
| | 12.9.3 | 1 |



## Learning Resources

- Physics Matter by Nick England
- Comprehensive Physics for 'O' Level Science by Charles Chew and Leong See Cheng
- Physics Matters GCE 'O' Level by Dr. Charles Chew, Chow Siew Foong, and Dr. Ho Boon Tiong

## Web Resources

https://www.youtube.com/watch?v=X3BYFv-CaJM
https://www.youtube.com/watch?v=NAaHPRsveJk
Total Internal Reflection and Critical Angle - YouTube
https://www.youtube.com/watch?v=_CT-wAIfOYQ
https://www.youtube.com/watch?v=Aggi0g67uXM

# Suggested Activities and/or Formative Assessment

## Activity 1

- Begin by discussing the concept of reflection of light with the students, explaining that when light hits a surface, it can bounce off and change direction.
- Distribute the mirrors to the students or place them at different locations around the room.
- Dim the lights in the room or move to a darker area.
- Instruct the students to use the flashlights or laser pointers to shine light onto the mirrors and observe the reflection.
- Encourage students to experiment with different angles and positions of the mirrors to observe how the light reflects and changes direction.
- Have students use the whiteboard or large piece of paper to draw the path of the light rays, including the incident and reflected rays, as well as the normal line (perpendicular to the mirror surface) at the point of incidence.
- Ask the students to measure the angle of incidence and the angle of reflection using protractors (if available) and compare the values.
- Discuss the law of reflection, emphasizing that the angle of incidence is equal to the angle of reflection.
- Facilitate a class discussion to share observations, draw conclusions, and reinforce the concept of reflection of light. Reflective Surfaces Investigation: Provide students with a variety of materials (e.g., aluminium foil, plastic wrap, glass, rough paper) and ask them to predict and test which materials reflect light the most effectively. Students can measure the intensity of reflected light using light sensors or by observing the brightness of the reflected light.

## Activity 2

- Share the rules of reflection by spherical Mirror and Draw two cases when object is at infinity and when object is beyond 2F.
- Provide groups with different spherical mirrors (concave and convex) and objects. Instruct them to compare and contrast the image formations using the spherical mirror equation and ray diagrams.
- Introduce the concept of image formation by spherical mirrors and the spherical mirror equation ($1/f = 1/p + 1/q$), where f is the focal length, do is the object distance, and di is the image distance.
- Provide students with a spherical mirror, an object, and a ruler or measuring tape.
- Instruct them to set up their mirror on a table or stand, ensuring it is stable and properly aligned.

- Have they place the object at various distances from the mirror, starting with distances greater than the focal length?
- Ask students to carefully measure and record the object distance (do) and the corresponding image distance (di) for each position of the object.
- Guide the students to calculate the reciprocal of the object distance (1/p) and the reciprocal of the image distance (1/p) for each measurement.
- Introduce ray diagrams as a visual representation of image formation and guide the students to create ray diagrams for selected object distances, comparing them to the calculated image distances.
- Allow time for students to experiment with different object distances and observe the corresponding image characteristics (real or virtual, magnified or diminished, etc.) using both the calculations and ray diagrams.

# Activity 3

### Exploring Refraction with a Glass of Water

- Fill a glass with water and place a pencil or straw in it. Observe how the pencil/straw appears bent at the water's surface.
- Discuss why this happens and introduce the term "refraction" to explain the phenomenon.
- Encourage students to experiment by placing objects of different shapes and sizes in the water to observe how they appear bent or distorted.

### The Magic Coin

- Ask students to place a coin in an empty glass and observe its apparent position.
- Fill the glass with water and ask students to observe how the coin's position appears to change.
- Explain that this happens due to refraction and discuss the role of light bending when it passes from air to water.

# Activity 4

- Set up the activity area by placing a white paper or surface on a table or wall.
- Place the rectangular transparent material (block) on the paper in a vertical position, with the parallel sides facing the paper.
- Choose a point near the top edge of the block as the light source. This can be done by using a ray box with a single opening or by directing a flashlight at an angle toward the block.
- Turn on the ray box or flashlight and project a light ray onto the block. The ray should be aimed slightly above the center of the top edge.
- Observe the path of the light ray as it enters the block. Note how the ray appears to bend or change direction.
- Use a protractor to measure the angle of incidence, which is the angle between the incoming light ray and a line perpendicular to the surface of the block. Record this angle.
- Continue observing the path of the light ray as it travels through the block.

- Measure the angle of refraction, which is the angle between the refracted light ray and the same perpendicular line on the opposite side of the block. Record this angle as well.
- Repeat steps 4-8 for different incident angles, varying the angle at which the light ray enters the block.

## Activity 5

- Provide a variety of transparent materials such as glass, plastic, acrylic, and gelatin.
- Shine a narrow beam of light (using a flashlight or laser pointer) through each material and observe how the light passes through.
- Discuss the different speeds at which light travels through each medium.
- Have students rank the materials based on the speed of light they observe, from slowest to fastest.
- Compare their rankings with the known refractive indexes of the materials and discuss any discrepancies or patterns.

## Activity 6

Take students to the laboratory and explain to them the refraction of light through prism.

## Activity 7

- Fill a clear glass or plastic container with water.
- Place the container on a flat surface.
- Position the white paper or surface behind the container.
- Turn off the lights in the room or conduct the activity in a dimly lit area to enhance visibility.
- Hold the flashlight or laser pointer near the side of the container, pointing towards the water at an angle.
- Observe the path of the light beam as it enters the water. Note the direction and any changes in the beam.
- Gradually increase the angle at which the light beam enters the water.
- Observe what happens to the light beam as the angle increases. Pay attention to any changes in the direction of the beam.
- Continue increasing the angle until you reach a point where the light beams no longer pass through the water but instead reflects back into the container.
- Discuss the phenomenon of total internal reflection and explain that it occurs when the angle of incidence exceeds the critical angle.
- Calculate the critical angle for the specific medium using the refractive index of water (or the relevant medium) and discuss its significance.
- Encourage students to experiment with different angles of incidence and observe the behavior of the light beam. They can measure and record the critical angle for different liquids or mediums.
- Explore real-life applications of total internal reflection, such as fiber optics and prism-based devices, and discuss their significance in various fields.

As an extension activity, students can investigate how changing the shape of the container or the refractive index of the medium affects the critical angle and total internal reflection.

## Activity 8

Demonstrate that light is refracted through lenses. Provide students with convex and concave lenses and ask them to make an image of a thing on the screen. They can move the object closer or away and observe the change in size of the image by using convex lenses and making a chart of their observations. Similarly take a concave lens and do the same and observe the image. Take the responses and explain them. tell them the rules of refraction from lens and draw one or two cases with them. discuss thin lens formula with student with sign convention.

## Activity 9

- Set up the activity area by placing the white paper or surface on a table.
- Obtain a magnifying glass or hand lens.
- Choose a small, printed text or image with fine details.
- Place the printed text or image on the white paper.
- Hold the magnifying glass or hand lens above the printed text or image, ensuring that it is focused correctly.
- Observe the magnified image and note any changes in size and clarity.
- Measure the size of the magnified image using a ruler or measuring tape. Record this measurement.
- Calculate the magnifying power using the formula: Magnifying Power = Size of Magnified Image / Size of the Object.
- Discuss the concept of magnifying power and explain that it represents the degree to which the object appears larger when viewed through a magnifying lens.
- Have students explore the effect of different distances between the magnifying lens and the object on the magnifying power. They can move the lens closer or farther from the object and observe the changes in magnification.
- Introduce the concept of resolving power. Explain that resolving power refers to the ability of an optical device to distinguish between two closely spaced objects or details.
- Discuss the factors that affect resolving power, such as the wavelength of light used, the aperture size of the lens, and the quality of the lens.
- Engage students in a discussion about how increasing the resolving power of an optical device can improve the clarity and level of detail in the observed image.
- Have students research and discuss real-life applications of magnifying power and resolving power, such as in microscopy, telescopes, and photography.

## Activity 10

Place an eye chart and ask student to read the smallest line on chart and measure the distance at which they can read it clearly. Measure the distance between the student and chart via ruler. Allow students to adjust their position, moving closer to or farther from the eye chart, to find the smallest line of letters they can read clearly.

Measure and record the new distance between the student and the eye chart.

Discuss the results with the students, comparing the distances they required to read the smallest line of letters. Emphasize that the smaller the distance, the better their least distant vision is Introduce a simple magnifying glass is a simple microscope and derive the formula for its magnifying power. Search for uses and working of simple microscope.

## Activity 11

- Introduce the compound microscope to students and briefly explain its purpose and importance in scientific research and observation.
- Show the students a compound microscope and its different parts, such as the eyepiece, objective lenses, stage, focus knobs, and illuminator.
- Engage the students in a discussion about the working principle of the compound microscope. Explain that the microscope uses a combination of lenses (eyepiece and objective lenses) to magnify the image and allow for detailed observation of small objects or specimens.
- Discuss the importance of adjusting the focus using the fine and coarse focus knobs to obtain a clear image. Emphasize the significance of proper lighting to illuminate the specimen and enhance visibility.
- Encourage the students to explore the microscope further by adjusting the magnification using different objective lenses and observing different specimens. also introduce formula for its magnifying power.
- Ask students to draw a ray diagram for the microscope.

## Activity 13

- Introduce the concept of a telescope to the students and explain its purpose in observing distant objects in space. Discuss the basic components of a telescope, including the objective lens, the eyepiece, and the tube.
- Provide students with the materials.
- Instruct them to cut two circular holes in the cardboard or foam board. One hole should be smaller and represent the eyepiece, while the other should be larger and represent the objective lens. Attach the two convex lenses to the cardboard or foam board using tape or glue. The shorter focal length lens should be placed closer to the smaller hole, representing the eyepiece, while the longer focal length lens should be placed closer to the larger hole, representing the objective lens. Instruct the students to assemble the cardboard or foam board structure into a tube, with the objective lens at the front end and the eyepiece at the back end.
- Have each group choose a distant object, such as a tree or building, and set it as the target for their telescope.

- Instruct the students to position themselves at a suitable distance from the target object, holding the telescope up to their eyes.
- Guide the students on how to adjust the position and distance between the objective lens and eyepiece to achieve a clear image of the target object.
- Once the students have aligned the lenses and focused the telescope, ask them to draw what they see on a piece of white paper or surface. Encourage them to label the different parts of the target object if applicable.
- After drawing their observations, ask the students to share their findings with the rest of the class. Discuss the similarities and differences in their observations.
- Engage the students in a discussion about the working principle of the telescope. Explain that the objective lens gathers light from the target object and forms an inverted image, which is then magnified and made upright by the eyepiece lens.
- Conclude the activity by discussing the practical applications of telescopes in astronomy, space exploration, and observing distant celestial objects.

## Activity 14

- Introduce the concept of vision defects to the students, explaining that they are common conditions that can affect how well a person sees.
- Discuss different types of vision defects, such as nearsightedness (myopia), farsightedness (hyperopia), astigmatism, and color blindness. Explain the characteristics and symptoms of each defect.
- Divide the students into pairs or small groups and provide each group with an eye chart or printed sheet with letters of varying sizes.
- Instruct each group to take turns reading the letters on the chart from a predetermined distance. This distance will be the starting point for the activity.
- Measure and record the distance at which each student can read the smallest line of letters clearly using a measuring tape or ruler.
- Discuss the results with the students, comparing the distances at which they required to read the smallest line of letters.
- Explain that the distance required to read the smallest line of letters indicates the presence and severity of a vision defect.
- If available, provide eye patches or blindfolds and ask students to cover one eye. Have them repeat the activity and measure the distance at which they can read the smallest line of letters with only one eye?
- Engage the students in a discussion about the possible causes and remedies for different vision defects. Discuss the role of corrective lenses, such as glasses or contact lenses, in improving vision.
- Encourage the students to research and discuss real-life examples of people with vision defects who have achieved success in various fields.
- Conclude the activity by highlighting the importance of regular eye exams and proper eye care to detect and manage vision defects.

## Activity 15

Verify the laws of reflection by using a plane mirror, common pins and sheet of paper.

## Activity 16

Verify the laws of refraction by using glass slabs, common pins and sheet of paper.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

| **Topic** | **Total Periods** |
|---|---|
| 13. Electrostatics | 17 |

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 13.1 Electric Charge | 13.1.1-13.1.2 | 1 |
| 13.2 Electrostatic Induction | 13.2.1-13.2.2 | 1 |
| 13.3 Electroscope | 13.3.1 | 1 |
| 13.4 Coulomb's law | 13.4.1-13.4.2 | 2 |
| 13.5 Electric Field and its intensity | 13.5.1-13.5.2 | 1 |
| 13.6 Electrostatic Potential | 13.6.1 | 1 |
| | 13.6.2-13.6.3 | 1 |
| 13.7 Application of Electrostatics | 13.7.1-13.7.2 | 1 |
| | 13.7.3 | 2 |
| 13.8 Capacitor and Capacitance | 13.8.1-13.8.2 | 1 |

| | | |
|---|---|---|
| | 13.8.3 | 2 |
| | 13.8.4 | 2 |
| 13.9 Different Types of Capacitors | 13.9.1 | 1 |

## Learning Resources

- Physics Matter by Nick England
- Comprehensive Physics for 'O' Level Science by Charles Chew and Leong See Cheng
- Complete Physics by Stephen Pople

## Suggested Activities and/or Formative Assessment

### Activity 1

- Rub a balloon against a wool cloth or fur vigorously for about 20-30 seconds. This will transfer electric charge to the balloon.
- Place the balloon on a table or desk and bring it close to small pieces of paper or a thin stream of water (from a faucet or dropper). Observe the behaviour of the paper or water when the balloon is brought near it. You will notice that the paper pieces are attracted to the balloon, or the water stream bends towards the balloon.
- Explain to the students that the rubbing of the balloon against the wool cloth or fur caused the balloon to become charged with static electricity. This charge creates an electric field around the balloon, which interacts with the charged particles in the paper or water, causing them to move.
- To further demonstrate the detection of electric charge, ask the students to rub the balloon against the wool cloth or fur again to recharge it.
- Instruct the students to stand near the balloon, without touching it, and raise their hand close to the balloon.
- They will observe their hair or any small lightweight objects, such as a small piece of tissue paper, being attracted to the balloon or even sticking to it.
- Explain that their body becomes charged with the opposite electric charge to that of the balloon. This causes their hair or small objects to be attracted to the balloon due to the electrostatic forces between opposite charges.

## Activity 2

- Introduce the concept of an electroscope to the students, explaining that it is a device used to detect and demonstrate the presence of electric charge.
- Show the students the electroscope and explain its components: a metal rod, a metal leaf, and a jar or container.
- Begin by demonstrating a neutral electroscope. Hold the metal rod of the electroscope and show the metal leaf hanging straight down.
- Rub the balloon or plastic rod vigorously with the wool cloth or fur to charge it with static electricity.
- Bring the charged balloon or plastic rod close to the metal rod of the electroscope without touching it.
- Observe the behaviour of the metal leaf. It should separate and stand away from the metal rod.
- Explain to the students that the presence of the charged object near the electroscope causes a transfer of electric charge. The like charges repel each other, causing the metal leaf to separate.
- To further demonstrate the effect, touch the metal rod of the electroscope with the charged object for a brief moment.
- Observe the behaviour of the metal leaf. It should collapse or come closer to the metal rod.
- Explain to the students that touching the metal rod with the charged object allows the excess charge to flow through the metal rod and the grounding wire (if used), neutralizing the electroscope. Repeat the process with different charged objects.

## Activity 3

- Assign one charged object as Object A and the other as Object B.
- Attach a string or thread to each object, creating two separate pendulums.
- Suspend Object A and Object B from a stable support so that they can swing freely without touching each other.
- Allow the pendulums to settle and ensure they are at rest.
- Measure and record the initial distance (d) between Object A and Object B using a ruler or measuring tape.
- Gently push Object A away from its equilibrium position and release it, allowing it to swing back and forth.
- Observe any changes in the swing of Object B. Does it move closer or farther away from Object A?
- Repeat the process, but this time push Object A with a greater force (by pulling it farther back) before releasing it.
- Observe and compare the behaviour of Object B in both cases. Does the distance between the objects change more or less compared to the previous case?
- Discuss the observations with the students. Explain that Coulomb's law states that the force between two charged objects is directly proportional to the

product of their charges and inversely proportional to the square of the distance between them.
- Relate the observations to Coulomb's law. When Object A is pushed away with a greater force, it carries a larger charge, resulting in a stronger force of interaction between the objects. This causes Object B to move closer or farther away with greater magnitude.

## Activity 4

- Provide students with paper, pencils, and a variety of small, charged objects (e.g., balloons, plastic rods).
- Instruct students to draw electric field lines around the charged objects to represent the direction and strength of the electric field.
- Encourage them to experiment with different charges and distances to observe how the electric field lines change.
- Discuss their drawings as a class, highlighting patterns and observations.

## Activity 5

- Introduce the concept of electrostatic potential to the students, explaining that it refers to the amount of electric potential energy per unit charge at a given point in an electric field. Arrange the conductive objects in the classroom, such as metal spheres or plates, at different locations. These will represent different points in the electric field.
- Connect the conductive objects to a power supply or static electricity source, ensuring that each object is at a different electric potential.
- If available, connect a voltmeter or electrostatic voltmeter to measure the electrostatic potential at each point. Alternatively, you can discuss the concept qualitatively without measuring precise values.
- Ask the students to observe and compare the conductive objects.

## Activity 6

Discuss why lightning and thunder is dangerous. Thunder clouds develop electrostatic charge due to friction which can induce charge on high rise building.

### Static Electricity and Safety

- Conduct a hands-on activity to demonstrate the dangers of static electricity and the importance of proper grounding.
- Show how static electricity can build up on objects and lead to unexpected shocks or sparks.
- Discuss safety measures such as grounding techniques and the use of anti-static materials in various industries.

### Applications in Photocopier

- Discuss how electrostatics is used in the functioning of photocopiers and laser printers.

- Explain the process of charging a photoreceptor drum with static electricity, attracting toner particles, and transferring the image onto paper.
- Show examples of photocopies or printed documents to emphasize the practical application of electrostatics in everyday life.

**Applications in Inkjet Printing**

- Demonstrate the working principle of an inkjet printer and its reliance on electrostatic forces.
- Explain how electrically charged droplets of ink are selectively propelled and deposited onto paper to create printed images or text.
- Discuss the advantages of inkjet printing, such as high-resolution output and precise colour reproduction.

## Activity 7

- Provide students with aluminium foil, cardboard, and a dielectric material (e.g., plastic sheet or wax paper). Instruct them to cut two squares or rectangles of the same size from the cardboard.
- Have students cover one side of each cardboard piece with aluminium foil.
- Place the dielectric material between the two foil-covered cardboard pieces, ensuring that the foil does not overlap.
- Use clips or rubber bands to hold the pieces together.
- Connect the foil on one side to a power supply (e.g., a battery) and the foil on the other side to an LED or small light bulb.
- Observe the light turning on when the circuit is completed, indicating the storage and release of electric charge in the capacitor.

**Charge and Discharge of Capacitors**

- Provide students with a capacitor, a resistor, a power supply, and a voltmeter.
- Connect the capacitor in series with the resistor, power supply, and voltmeter.
- Set the power supply to a low voltage.
- Observe and record the voltage across the capacitor over time as it charges.
- Repeat the experiment, but this time disconnect the power supply and measure the voltage across the capacitor as it discharges.
- Discuss the time constant and how it affects the charging and discharging processes.

## Activity 8

Introduce the concept of equivalent capacitance to the students, explaining that it refers to the combined capacitance of multiple capacitors connected in various configurations.

Provide students with the capacitors and connecting wires. Ensure that the capacitors have clearly labelled capacitance values.

**Start with a series connection**

- Instruct the students to connect the capacitors in series, one after another, using the connecting wires.
- Encourage them to measure the capacitance of the entire series combination using the capacitance meter or by calculating the reciprocal of the total capacitance ($1/C_E = 1/C_1 + 1/C_2 + 1/C_3 + ...$).
- Alternatively, if a voltmeter is available, students can connect the series combination to a power supply and measure the voltage across the combination to indirectly calculate the equivalent capacitance.
- Move on to a parallel connection: Instruct the students to disconnect the capacitors from the series configuration and connect them in parallel instead. Again, encourage them to measure the capacitance of the entire parallel combination using the capacitance meter or by directly summing the individual capacitances ($C_E = C_1 + C_2 + C_3 + ...$).
- Alternatively, if a voltmeter is available, students can connect the parallel combination to a power supply and measure the voltage across each capacitor to indirectly calculate the equivalent capacitance.

**Discuss the observations**

- Lead a class discussion about the observations and comparisons between the series and parallel configurations.
- Emphasize that the equivalent capacitance is different for series and parallel connections, demonstrating how combining capacitors affects the overall capacitance.

## Activity 9

Provide students with different types of capacitors. Discuss with students the structure and applications. Also discuss the variable and fixed capacitors.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

**Topic** **Total Periods**

14. Current Electricity 18

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 14.1 Electric Current | 14.1.1-14.1.2 | 1 |
| 14.2 Potential difference and Electromotive Force (e.m.f.) | 14.2.1-14.2.2 | 2 |
| 14.3 Ohm's Law | 14.3.1,14.3.4 | 1 |
| | 14.3.2-14.3.3 | 1 |
| 14.4 Electric Circuits | 14.4.1-14.3.3 | 2 |
| | 14.4.4 | 1 |
| 14.5 The I-V Characteristics of Ohmic and Non-Ohmic Conductor | 14.5.1 | 1 |
| 14.6 Electrical Power and Joule's Law | 14.6.1-14.6.2 | 1 |
| | 14.6.3-14.6.4 | 2 |
| | 14.6.5 | 1 |

| | | |
|---|---|---|
| 14.7 Uses of Circuit Components | 14.7.1 | 1 |
| 14.8 Measuring Instruments (Galvanometer, Ammeter, Voltmeter) | 14.8.1-14.8.2 | 2 |
| 14.9 Alternating Current (AC) | 14.9.1-14.9.2 | 1 |
| 14.10 Safety Measures | 14.10.1-14.10.2 | 1 |

## Learning Resource

- Physics Matter by Nick England

## Suggested Activities and/or Formative Assessment

### Activity 1

Start by introducing the concept of electric current to the students, explaining that it refers to the flow of electric charge in a circuit.

**Set Up a Simple Circuit**

- Connect the positive terminal of the battery/power supply to one end of the bulb/LED using a conductive wire.
- Connect the other end of the bulb/LED back to the negative terminal of the battery/power supply using another conductive wire.
- Make sure the circuit is complete and closed.
- Discuss the components of the circuit:
- Explain that the battery/power supply provides the source of electric potential difference, or voltage, which drives the electric current.
- Emphasize that the bulb/LED is a load or a device that converts electrical energy into light energy.
- Ask students to predict what will happen when the circuit is closed. Encourage them to share their ideas.

### Close The Circuit

- Connect the two free ends of the conductive wires together using alligator clips or by holding them firmly.
- Observe the bulb/LED lighting up as the circuit is closed and the electric current flows.

### Discuss the Observations

- Lead a class discussion about what happened when the circuit was closed.
- Explain that the electric current flows from the positive terminal of the battery/power supply, through the wires and bulb/LED, and back to the negative terminal of the battery/power supply.
- Explain the difference between a conventional current and a non-conventional current.

## Activity 2

- Begin by introducing the concepts of potential difference and electromotive force (EMF) to the students.
- Explain that potential difference (or voltage) is the measure of the electric potential energy difference between two points in a circuit.
- Discuss how EMF is the voltage provided by a power source, such as a battery, to maintain the electric current in a circuit.
- Set up a simple circuit:
- Connect the positive terminal of the battery/power supply to one end of the voltmeter using a conductive wire.
- Connect the negative terminal of the battery/power supply to the other end of the voltmeter using another conductive wire.
- Make sure the circuit is complete and closed.
- Explain the role of the voltmeter:
- Discuss how the voltmeter measures the potential difference between the two points in the circuit.
- Demonstrate potential difference:
- Set the battery/power supply to a specific voltage setting (e.g., 3V).
- Observe and note the reading on the voltmeter, indicating the potential difference across the battery terminals. Repeat the process with different voltage settings to show the variation in potential difference.

### Discuss the Observations

Lead a class discussion about the relationship between the voltage setting on the battery/power supply and the potential difference measured by the voltmeter.

Emphasize that the potential difference depends on the energy provided by the power source.

## Activity 3

### Circuit Design Challenge

- Divide students into small groups and provide each group with a set of resistors, a power supply, and a voltmeter.
- Challenge the groups to design circuits with specific voltage requirements (e.g., circuits with a voltage drop of 6V, 12V, etc.).
- Instruct the groups to measure the current flowing through the circuit using the voltmeter and adjust the resistance values to achieve the desired voltage.
- Encourage students to calculate and compare the resistance values obtained with the ones predicted by Ohm's Law.
- Allow groups to share their circuit designs and discuss their findings with the class.

## Activity 4

- Discuss the role of conductors and insulators.
- Explain that conductive materials, such as metals, allow the flow of electric current, while insulating materials prevent or inhibit the flow.
- Discuss examples of conductors and insulators in daily life and their importance in electrical circuits.
- discuss Ohm's Law and its limitations.
- Make a circuit with wire bulb battery and wire. As soon as the circuit is complete the bulb will start to glow now change the wire between the battery and bulb with different gauge wires and note the intensity of the bulb glowing by conducting this experiment explain students the factors that affect the resistance in a metal conductor.

## Activity 5

- Provide students with a bulb, resistance, battery and wires and ask them or assist them to make a basic electric circuit, ammeter and voltmeter to explain the potential difference and electric charge.
- Introduce the concept of series and parallel circuits to the students.
- Provide students with batteries, bulbs/LEDs, wires, and alligator clips.
- Instruct students to construct both series and parallel circuits using the given materials.
- Ask students to observe and compare the brightness of the bulbs/LEDs in each type of circuit.
- Encourage students to discuss their observations and explain the differences between series and parallel circuits in terms of current flow and resistance.
- Further you can increase / decrease the number of resistances to explain the importance of equivalent resistance in a circuit. derive the formula for equivalent resistance in series and parallel combination.

## Activity 6

- Introduce the concept of the I-V characteristic curve:
- Explain that the I-V characteristic curve shows the relationship between the current (I) flowing through a component and the voltage (V) applied across it.
- Emphasize that different components exhibit different characteristic curves, depending on their behavior.
- Set up the circuit for an ohmic conductor:
- Connect the positive terminal of the power supply to one end of the resistor using a connecting wire.
- Connect the other end of the resistor back to the negative terminal of the power supply using another connecting wire.
- Connect the ammeter in series with the resistor to measure the current flowing through it.
- Connect the voltmeter in parallel across the resistor to measure the voltage across it.
- Measure the current and voltage for the ohmic conductor:
- Turn on the power supply and adjust it to a low voltage setting.
- Record the current and voltage readings from the ammeter and voltmeter, respectively.
- Repeat the measurements for different voltage settings, gradually increasing the voltage.
- Plot the I-V characteristic curve for the ohmic conductor:
- Using the recorded data, plot a graph with voltage (V) on the x-axis and current (I) on the y-axis.
- Connect the data points to create the I-V characteristic curve for the ohmic conductor.
- Discuss how the curve is a straight line passing through the origin, indicating a linear relationship between current and voltage.
- Set up the circuit for a non-ohmic conductor:
- Replace the resistor with a non-ohmic conductor, such as a light bulb or diode.
- Connect the ammeter and voltmeter as before.
- Measure the current and voltage for the non-ohmic conductor:
- Repeat the process of adjusting the power supply voltage and recording the current and voltage readings.
- Note any deviations from the linear relationship observed in the ohmic conductor.
- Plot the I-V characteristic curve for the non-ohmic conductor:
- Using the recorded data, plot a graph with voltage (V) on the x-axis and current (I) on the y-axis.
- Connect the data points to create the I-V characteristic curve for the non-ohmic conductor.
- Discuss how the curve differs from the ohmic conductor, highlighting any nonlinear behavior or threshold effects.

- Compare and contrast the I-V characteristic curves for the ohmic and non-ohmic conductors.
- Discuss the implications of the curves in terms of the behavior of the components.
- Emphasize how ohmic conductors exhibit a linear relationship between current and voltage, while non-ohmic conductors may show nonlinear behavior or threshold effects.

## Activity 7

### Experimental Setup

- Set up a circuit with a resistor connected to the power supply in series.
- Connect the ammeter in series to measure the current flowing through the circuit.
- Connect the voltmeter in parallel across the resistor to measure the voltage across it.
- Ensure that all connections are secure.

### Measurement and Calculation

- Start the circuit and record the initial readings of voltage (V) and current (I) from the voltmeter and ammeter, respectively.
- Start the stopwatch or timer to measure the time (t).
- Allow the current to flow for a fixed duration (e.g., 1 minute).
- After the predetermined time, stop the stopwatch or timer and record the final readings of voltage and current.
- Calculate the average values of voltage (V), current (I), and time (t) from the initial and final readings.

### Calculation of Power and Heat

- Calculate the electric power (P) using the formula $P = VI$, where V is the average voltage, and I is the average current.
- Calculate the heat produced (H) using Joule's Law Formula $H = I^2Rt$, where I is the average current, R is the resistance of the circuit (known from the resistor value), and t is the time.

### Analysis and Discussion

- Compare the calculated electric power (P) with the measured power obtained from the power supply.
- Discuss the relationship between the current, voltage, resistance, and power.

## Activity 8

Provide students with a set of data containing current, and voltages and help them out to calculate the cost of energy consumed.

## Activity 9

Provide students with the physical components of a circuit and explain to them their application in daily life usage.

## Activity 10

Give students a circuit containing a power source, resistor and bulb and ask them to measure current, voltages in a circuit by using different measuring instruments like Ammeter, Voltmeter and Galvanometer etc.

Also provide students with a circuit contain bulbs, power source and wires and ask them to connect and observe in different configurations like in series and parallel and ask them to measure the current and voltage across each bulb. After finding the results discuss and explain the effects of series and parallel configuration on a Load/ Bulb.

## Activity 11

Explain that AC is commonly used in homes and buildings to power electrical devices and the function of a live neutral and ground wire.

**Setting up the Circuit**

- Connect the positive terminal of the power supply to one end of the bulb/LED using a connecting wire.
- Connect the other end of the bulb/LED back to the negative terminal of the power supply using another connecting wire.
- Make sure the connections are secure.

**Observing the Bulb/LED**

- Turn on the power supply and observe the behavior of the bulb/LED.
- Note that the bulb/LED appears to be continuously glowing, but it is actually rapidly turning on and off.
- Measuring Voltage:
- Measure the voltage across the bulb/LED using a voltmeter.
- Observe that the voltage reading fluctuates, indicating the changing nature of AC.

## Activity 12

- Facilitate a discussion on each identified hazard and discuss the potential risks and consequences.
- Encourage students to explain why each hazard is dangerous and how it can be avoided.
- Provide students with a list of electrical safety guidelines and precautions.
- Discuss each guideline and its importance in preventing accidents and ensuring electrical safety. Examples of guidelines include proper grounding,

avoiding overloading circuits, using insulated tools, and turning off power before conducting repairs or maintenance.

## Activity 13

Write the point of differences between a conventional and non-conventional current.

## Activity 14

Write points of differences between electromotive force (EMF) and potential difference (PD). Provide students with voltmeter bulb and cell to find emf and PD across bulb.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

## Topic | Total Periods

15. Electromagnetism — 9

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 15.1 Magnetic Effect of a Steady current | 15.1.1 | 1 |
| 15.2 Force on a Current Carrying Conductor in Magnetic field | 15.2.1 | 1 |
| 15.3 Turning Effect on a Current Carrying Coil in Magnetic Field | 15.3.1 | 1 |
| 15.4 Direct Current (DC) Motor | 15.4.1 | 1 |
| 15.5 Electromagnetic Induction | 15.5.1-15.5.3 | 2 |
| 15.6 Alternating Current (AC) Generator | 15.6.1 | 1 |
| 15.7 Induction | 15.7.1-15.7.2 | 1 |
| 15.8 Transformer | 15.8.1-15.8.2 | 1 |



## Learning Resources

- Physics Matter by Nick England
- Ordinated Physics by Stephen Pople

## Web Resources

https://www.youtube.com/watch?v=-7U4nJphU88

https://www.youtube.com/watch?v=j_F4limaHYI

Electromagnetic Induction - YouTube

https://www.youtube.com/watch?v=YkHhFho6L2Y

Physics - Understanding Electromagnetic induction (EMI) and electromagnetic force (EMF) - Physics - YouTube

Self Induction and Mutual Induction - YouTube

https://www.youtube.com/watch?v=7RtBUEZbKml

## Suggested Activities and/or Formative Assessment

### Activity 1

- Discuss how a current-carrying wire creates a magnetic field around it.
- Place a compass near the wire but not in direct contact with it.
- Observe the behavior of the compass needle.
- Note any deflection or movement of the compass needle.
- Now switch the battery terminals and observe the compass needle again.
- Discuss the observations with the students.
- Emphasize that the deflection or movement of the compass needle indicates the presence of a magnetic field around the current-carrying wire.
- Explain that reversing the direction of the current in the wire changes the direction of the magnetic field.
- Relate the activity to real-life examples, such as the operation of electromagnets or the behavior of current-carrying wires in motors.

### Activity 2

- Take a wire and wind it around the iron nail to form a coil and connect it with a battery.
- Place the magnetic compass near the coil but not in direct contact with it.
- Observe the behavior of the compass needle.
- Note the direction in which the compass needle aligns or deflects.
- Repeat it with polarity reversed.
- Discuss the observations with the students.
- Explain that the deflection or alignment of the compass needle indicates the presence of a magnetic field and the force experienced by the current-carrying coil.
- Emphasize that reversing the direction of the current in the coil changes the direction of the force on the coil.

## Activity 3

- Take a magnet and securely attach it to a stable surface (such as a table) with the north and south poles facing up.
- Cut a piece of copper wire, approximately 20 cm long.
- Strip the insulation from both ends of the wire.
- Create a small loop at one end of the wire, forming a coil. Secure it with tape, if needed.
- Attach the other end of the wire to a paperclip or small nail, ensuring a firm connection.
- Place the paper clip or nail vertically on the table so that it can rotate freely.
- Connect one end of the wire (the side attached to the coil) to the positive terminal of the battery.
- Connect the other end of the wire (attached to the paperclip or nail) to the negative terminal of the battery.
- The coil will start to rotate. Repeat with polarity reversed.
- Discuss with students how the interaction between the magnetic field of the coil and the magnetic field of the stationary magnet results in a rotational force on the coil, causing it to rotate.

## Activity 4

- Take a copper wire and strip the insulation from both ends.
- Create a coil by wrapping the wire around a cylindrical object (such as a pen or a marker) several times.
- Place the magnet near one end of the coil.
- Discuss how the magnet creates a magnetic field in the vicinity of the coil.
- Connect the voltmeter to the ends of the coil using connecting wires.
- Note if there is any current or voltage detected.
- While keeping the coil stationary, move the magnet towards the coil.
- Observe the reading on the voltmeter/ammeter.
- Note any change in the current or voltage detected.
- Discuss the observations with the students.
- Explain that the relative motion between the magnetic field and the coil induces an electric current in the wire.

## Activity 5

- Take a coil of wire and attach its ends to a galvanometer or voltmeter using connecting wires.
- Make sure the coil is free to rotate around its axis.
- Tape the coil to a rigid support to keep it stable.
- Place the strong magnet near the coil without touching it.
- Ensure that the orientation of the magnet's poles is parallel to the plane of the coil.
- Rotate the coil rapidly by spinning it around its axis.

- Make sure the coil remains in the magnetic field of the magnet during rotation.
- Observe the reading on the galvanometer or voltmeter.
- Discuss the observations with the students.
- Explain that as the coil rotates in the magnetic field, the magnetic flux through the coil changes, resulting in the induction of an alternating current (AC).
- Induced current changes as the coil completes each rotation.

## Activity 6

- Take a coil of wire and attach its ends to a voltmeter using connecting wires.
- Make sure the coil is free to move.
- Place the magnet near the coil, but not in direct contact.
- Ensure that the magnet and the coil are oriented such that their poles are facing each other.
- Observe the reading on the galvanometer or voltmeter.
- Note if there is any current or voltage detected.
- While keeping the coil stationary, move the magnet towards the coil.
- Observe the reading on the voltmeter.
- Note any change in the current or voltage detected.
- Discuss the observations with the students.
- Explain that the relative motion between the magnetic field and the coil induces an electric current in the wire.
- Emphasize that the magnitude and direction of the induced current depend on the rate of change of the magnetic field and the orientation of the coil.
- Relate the activity to real-life applications of electromagnetic induction, such as transformers and electric generators.

## Activity 7

- Take two coils of wire, one for the primary coil and the other for the secondary coil.
- Connect the primary coil to the power source using connecting wires.
- Attach the voltmeter to the secondary coil using connecting wires.
- Ensure that the coils are well-insulated and secured.
- Place the coils close to each other, but without touching.
- If available, you can insert an iron core into the center of the coils to enhance the magnetic coupling (optional).
- Connect the power source to the primary coil and switch it on.
- Observe the reading on the voltmeter connected to the secondary coil.
- Note any change in the current or voltage detected.
- Discuss the observations with the students.
- Explain that when an alternating current (AC) flows through the primary coil, it generates a changing magnetic field.
- Emphasize that this changing magnetic field induces an alternating current in the secondary coil through electromagnetic induction.

- Discuss the relationship between the number of turns in the primary and secondary coils and the voltage and current transformation in a transformer.
- Relate the activity to real-life applications of transformers, such as power transmission and voltage conversion.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

**Topic** **Total Periods**

16. Introductory Electronics 7

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 16.1 Thermionic Emission | 16.1.1 | 0.5 |
| 16.2 Electron Gun and Cathode Rays | 16.2.1 | 0.5 |
| 16.3 Deflection of Electron by Electric Field | 16.3.1 | 0.5 |
| 16.4 Deflection of Electron by Magnetic Field | 16.4.1 | 0.5 |
| 16.5 Cathode Rays Oscilloscope CRO | 16.5.1 | 1 |
| 16.6 Introduction to Electronics | 16.6.1 | 0.5 |
| 16.7 Analogue and Digital Electronics | 16.7.1 | 0.5 |
| | 16.7.2-16.7.3 | 1 |
| 16.8 Logic Gates | 16.8.1-16.8.2 | 1 |
| | 16.8.3 | 1 |

# Learning Resource

- Comprehensive Physics for 'O' Level Science by Charles Chew and Leong See Cheng

# Web Resources

https://www.youtube.com/watch?v=QhG7u9PXG88

https://www.youtube.com/watch?v=_CsLU-1VGug

https://www.youtube.com/watch?v=eFxJuEG-1q4

https://www.youtube.com/watch?v=RwQbID53f5o

# Suggested Activities and/or Formative Assessment

## Activity 1

**Materials**

- A power source (e.g., a battery or power supply).
- Two metal plates (e.g., copper or aluminum).
- Wires for connecting the plates to the power source.
- A low-voltage bulb or an ammeter

**Procedure**

- Connect the positive terminal of the power source to one metal plate and the negative terminal to the other metal plate. Ensure that the plates are not touching each other.
- Make sure the power source is turned off and set to a low voltage.
- Connect the bulb or ammeter to the metal plates in series.
- Turn on the power source and gradually increase the voltage.
- Observe the bulb or the ammeter. You should start seeing a glow in the bulb or a current flowing through the ammeter.
- This glow or current is a result of thermionic emission, where electrons are emitted from the heated surface of one of the metal plates and are attracted to the other plate due to the voltage difference.

**Discussion:**

- Ask students to describe their observations. What did they see when they increased the voltage? Did the brightness of the bulb or the current through the ammeter change?
- Explain that the phenomenon they observed is known as thermionic emission, where the heat causes the electrons to gain enough energy to overcome the attractive forces of the metal and be emitted into the surrounding space.

- Discuss the importance of thermionic emission in various devices, such as vacuum tubes, cathode-ray tubes, and some types of electron microscopes.
- Use low voltages to ensure the safety of the students.
- Make sure the metal plates do not touch each other to avoid short circuits.
- Handle the equipment and wires carefully to prevent electric shocks.
- Provide proper supervision during the activity.
- Note: This activity provides a basic demonstration of thermionic emission. For more advanced experiments or detailed studies, additional equipment and safety measures may be necessary.

## Activity 2

- Divide the students into two groups: Group A and Group B.
- Give Group A a set of picture cards or symbols and ask them to transmit the information to Group B using an analog signal.
- Group A can represent the picture cards/symbols by physically demonstrating them (e.g., using hand gestures or body movements).
- Group B should try to interpret the analog signal and guess the correct picture card/symbol.
- Now, ask Group A to transmit the same set of picture cards/symbols to Group B, but this time using a digital signal.
- Group A can represent each picture card/symbol using a binary code. For example, they can assign a unique sequence of "0" and "1" for each picture card/symbol.
- Group B should interpret the digital signal and decode the binary sequences to identify the correct picture cards/symbols.
- Compare the results of the two transmissions and discuss the differences between analog and digital signals.

## Activity 7

Draw analogous using two circuits on board. First containing switches in series along with bulb and cells connected in series and other switches connected in parallel with bulb and cell in series. take all possible combinations of switches both off, one OFF and other ON, On and OFF and both ON. Observe OR write under what condition bulb will glow and not glow. Make a table of observation similarly do the same by connecting switch in parallel and note the observation in form of table. than explain the action of gate their symbols.

## Activity 12

- Ask the students to compare the accuracy of the information transmitted using analog and digital signals.
- Discuss how digital signals can carry more information accurately compared to analog signals.
- Explain that digital signals represent information as discrete values, typically using binary codes (0s and 1s). These discrete values allow for precise representation and reconstruction of the original information.

- Highlight the advantages of digital signals, such as their ability to transmit information over long distances without significant loss or degradation.
- Discuss real-life examples of digital signal applications, such as digital communication systems (e.g., the Internet), digital audio and video formats, and digital storage systems.
- Encourage students to think about the widespread use of digital signals in modern technology and how they have revolutionized communication, entertainment, and information storage.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

| **Topic** | **Total Periods** |
|---|---|
| 17. Information and Communicational Technology | 5 |

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 17.1 Components of IT | 17.1.1 | 1 |
| 17.2 Flow of Information | 17.2.1 | 1 |
| 17.3 Communication Technology | 17.3.1-17.3.2 | 1 |
| 17.4 Storing Information | 17.4.1 | 1 |
| 17.5 Handling Information | 17.5.1 | 1 |

## Suggested Activities and/or Formative Assessment

### Activity 1

Divide class into five groups. Assign each SLO to each group to search for information and make a presentation. You may assign this work in winter break to search for information and after break they can sit in their respective groups, share information and make presentations for the whole class.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

| **Topic** | **Total Periods** |
|---|---|
| 18. Radioactivity | 12 |

| Sub-Topic | Range of SLOs | Periods (40 mins) |
|---|---|---|
| 18. Atom and atomic Nucleus | 18.1.1-18.1.4 | 1 |
| 18.2 Natural Radioactivity | 18.2.1-18.2.3 | 2 |
| | 18.2.4 | 1 |
| 18.3 Natural Transmutations | 18.3.1 | 1 |
| 18.4 Background Radiation | 18.4.1-18.4.2 | 1 |
| 18.5 Half-Life | 18.5.1-18.5.2 | 2 |
| 18.6 Radio Isotopes | 18.6.1-18.6.2 | 1 |
| 18.7 Fission and Fusion | 18.7.1 | 2 |
| 18.8 Hazards of Radioactivity and Safety Measures | 18.8.1 | 1 |

# Learning Resources

- Comprehensive Physics for 'O' Level Science by Charles Chew and Leong See Cheng
- Physics Matter by Nick England

# Web Resources

https://www.youtube.com/watch?v=ZsWMxwe7IJQ

https://www.youtube.com/watch?v=lCr3oPusMos

https://www.youtube.com/watch?v=zXw2cOSBB8E

https://www.youtube.com/watch?v=ZKHpix5dgAU

https://www.youtube.com/watch?v=g_BUbElyaz8

https://www.youtube.com/watch?v=Z4GV13xB00U

# Suggested Activities and/or Formative Assessment

## Activity 2

Explain that alpha particles consist of two protons and two neutrons, beta particles are electrons or positrons, and gamma rays are high-energy electromagnetic radiation.

## Activity 3

Begin by discussing the concept of background radiation and its sources. Explain that background radiation is the ionising radiation present in the environment from natural and artificial sources. Ask questions such as: What sources do you think contribute to background radiation? Do you think the radiation levels will be the same everywhere? Assign students a research task to investigate specific sources of background radiation, such as cosmic radiation, radon gas, or medical imaging.

## Activity 4

To explore the concept of half-life and its application to radioactive decay.

**Materials:**

- A set of 100 objects (e.g., coins, counters, or any other small items).
- A container or bag
- Stopwatch or timer
- Chart paper or whiteboard
- Writing materials

**Procedure**

- Begin by explaining the concept of radioactive decay and half-life to the students.
- Describe that radioactive materials decay over time, and the half-life is the time it takes for half of the radioactive atoms in a sample to decay. Half-Life Demonstration: Distribute the set of 100 objects to each student or group. These objects will represent radioactive atoms in a sample.
- Instruct the students to start with all the objects in the container or bag.
- Set a timer for a specific time interval, such as one minute, and tell the students that this represents one half-life.
- When the timer starts, ask the students to remove half of the objects from their collection and set them aside. This represents the decayed atoms.
- After the time interval, stop the timer and instruct the students to repeat the process, removing half of the remaining objects and setting them aside.
- Continue this process for several half-life intervals, recording the number of remaining objects after each interval.
- Gather the students together and ask them to share their observations and the number of remaining objects after each half-life interval.
- Create a chart or table on the chart paper or whiteboard to record the data collected by the students.

**Graphing the Decay:**

Use the collected data to plot a graph showing the number of remaining objects (y-axis) against the number of half-life intervals (x-axis).

Discuss the shape of the graph and how it demonstrates the exponential decay pattern characteristic of radioactive substances.

**Half-Life Calculation:**

Guide the students to calculate the approximate half-life based on their data. They can find the time interval that corresponds to each half-life by dividing the total time by the number of intervals.

**Discussion and Conclusion:**

Lead a discussion to reinforce the concept of half-life and its significance in radioactive decay.

Discuss real-life applications of half-life, such as radiocarbon dating or the use of radioactive isotopes in medical treatments.

Summarize the activity and key concepts learned, emphasizing the exponential decay pattern and the unique half-life characteristic of radioactive materials.

**Note:** Emphasize that this activity simulates the concept of half-life using a simplified model. It provides a visual representation of how the number of radioactive atoms decreases over time. Remind students that radioactive decay is a probabilistic process, and individual atoms may not necessarily decay at the exact half-life interval.

## Activity 5

To demonstrate the processes of nuclear fission and fusion by building atomic models and explaining the differences between the two reactions.

**Materials:**

- Styrofoam balls or modeling clay (different colors)
- Toothpicks or small wooden sticks
- Markers or labels for writing on the balls/clay
- Poster board or large paper for presentations

**Procedure**

- Divide the students into small groups of 3-4 members.
- Provide each group with the necessary materials (balls/clay, sticks, markers, etc.).
- Explain to the students the concepts of nuclear fission and fusion. Discuss the differences between the two reactions: Instruct each group to create a visual representation of a nuclear fission and fusion reaction using the provided materials. They can use different-colored balls/clay to represent different atomic nuclei.
- For nuclear fission, they should show the process of a heavy nucleus splitting into two or more smaller nuclei.
- For nuclear fusion, they should demonstrate the process of two light nuclei combining to form a heavier nucleus. Encourage the students to be creative and think about how they can visually represent the release of energy in each reaction.

## Activity 6

Explain to the students the basic concepts of radioactivity and the potential hazards associated with it, including radiation exposure and contamination. Instruct each group to create a poster or infographic that educates others about the hazards of radioactivity and safety measures to minimize the risks. Each group should focus on one specific aspect of radioactivity, such as radiation types, sources of exposure, or safety guidelines.

Provide students with access to reference materials or online resources to gather information about the hazards and safety measures. Encourage them to cite their sources and verify the accuracy of the information they find.

## Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

**Note:** This teacher-led pacing guide has been developed for AKU-EB affiliated schools to facilitate them by

- ensuring smooth transition of a school's academic year.
- ensuring curricular continuity in schools.
- predicting the time and pace of syllabi implementation.

This document also contains **suggested activities and/or formative assessments** that may enhance the learning experience. Please note that these activities are meant to serve as suggestions. As educators, you have the flexibility and autonomy to adapt and modify them to best suit the needs of your students and the dynamics of your classroom.

You are advised to use an ad-blocker while accessing the websites and web resources. In case any website is not functional for any reason, you may inform us at examination.board@aku.edu for an alternative or search material via any search engine.