



ADVANCED SECONDARY PHYSICS

TOPICS, COMPETENCIES AND LEARNING OUTCOMES

SENIOR FIVE TERM 1

TOPIC 1: MEASUREMENT AND DIMENSIONS OF PHYSICAL QUANTITIES

DURATION: 10 Periods

Competency: The learner uses a variety of instruments to accurately measure physical quantities and applies the concept of dimensions to establish the relation between these quantities.

Learning Outcomes

The learner should be able to:

1. Measure a variety of physical quantities in the environment with minimal errors. (v/a, s, gs)
2. Analyse the dimensions of a variety of derived physical quantities and use them to check the consistency of equations. (v/a, u, s, gs)

TOPIC 2: STATICS

DURATION: 16 Periods

Competency: The learner investigates the effect of a number of forces on a system and how the centre of gravity relates to the stability of mechanical structures.

Learning Outcomes

The learner should be able to:

1. Determine the resultant of vectors in different situations. (v/a, u, s)
2. Appreciate the concepts of moments and torque in the construction of different structures. (u, s, gs, v/a)

TOPIC 3: LINEAR MOTION**DURATION:** 38 Period**Competency:** The learner investigates the effect of force on the motion of bodies on land, water and air, and devises safety precautions for users of automobiles.**Learning Outcomes**

The learner should be able to:

1. Derive the equations describing the linear motion of uniformly accelerated objects and apply them in a variety of situations. (u, s, gs)
2. Determine the relative velocity and the distance of closest approach for moving bodies in real life. (u, s, gs)
3. Verify the principle of conservation of linear momentum and apply it in a variety of situations. (u, s, gs)
4. Apply Newton's laws of motion in different situations. (u, s, gs)

TOPIC 4: MOTION UNDER GRAVITY**DURATION:** 14 Periods**Competency:** The learner investigates the effect of force on bodies moving under gravity and the applications of this phenomenon in different situations.**Learning Outcomes**

The learner should be able to:

1. Analyse the behaviour of bodies moving under gravity. (u, s, gs)
2. Derive the equations of projectile motion and apply them in different real-life situations. (v/a, u, s, gs)

TOPIC 5: WORK, ENERGY AND POWER**DURATION:** 16 Periods**Competency:** The learner investigates the resources and transformations of energy in the environment in order to ensure sustainable and improved efficiency of energy utilisation.**Learning Outcomes**

The learner should be able to:

1. Derive expressions for work, power and energy, and apply them to solve real-life problems. (u, s, gs)
2. Explain the work-energy theorem, conservative and non-conservative force fields and how they relate to different bodies. (u, s, gs)
3. Describe the structure and the energy production process of the Sun and its implication to life on Earth. (u, v/a, gs)
4. Apply the concepts of renewable and nonrenewable energy resources in the conservation of energy. (u, s, gs, v/a)

TOPIC 6: SOLID FRICTION**DURATION: 14 Periods**

Competency: The learner investigates factors that determine solid friction and its effect on static and dynamic systems, and uses this concept to model efficient systems with minimised friction.

Learning Outcomes

The learner should be able to:

1. Investigate the nature of friction between static bodies and its implications. (u, s, gs, v/a)
2. Investigate the effects of friction on dynamic bodies in order to improve the operation of systems. (u, s, gs)

SENIOR FIVE TERM 2**TOPIC 7: FLUID MECHANICS****DURATION: 20 Periods**

Competency: The learner investigates the effect of molecular forces in fluids, fluid pressure and their applications in fluid systems.

Learning Outcomes

The learner should be able to:

1. Examine molecular forces in liquids and their implications. (u, s, gs)
2. Assess the application of pressure in fluids in different situations. (s, u)
3. Explain pressure variations in flowing fluids and its applications in variety of situations. (u, s, v/a)

TOPIC 8: MECHANICAL PROPERTIES OF MATTER**DURATION: 12 Periods**

Competency: The learner explores the effects of force on the strength of different materials in order to guide on the selection of appropriate materials for construction work.

Learning Outcomes:

The learner should be able to:

1. Investigate the elastic and plastic behaviour of stretched materials and their implications. (s, gs)
2. Investigate Young's Modulus and the work done during elastic extension and compression process of elastic materials. (u, s, gs, v/a)

TOPIC 8: MECHANICAL PROPERTIES OF MATTER**DURATION: 12 Periods**

Competency: The learner explores the effects of force on the strength of different materials in order to guide on the selection of appropriate materials for construction work.

Learning Outcomes:

The learner should be able to:

3. Investigate the elastic and plastic behaviour of stretched materials and their implications. (s, gs)
4. Investigate Young's Modulus and the work done during elastic extension and compression process of elastic materials. (u, s, gs, v/a)

TOPIC 9: THERMOMETRY**DURATION: 14 Periods**

Competency: The learner investigates the mode of operation of different types of thermometers and their applications in the real world.

Learning Outcomes

The learner should be able to:

1. Relate the expressions of temperature scales in order to solve real- life problems. (k, s, gs, v/a)
2. Compare different types of thermometers and how they are used in real life. (u, s, gs, v/a)

TOPIC 10: HEAT QUANTITIES**DURATION: 16 Periods**

Competency: The learner explores the behaviour of substances when heat is applied to them in order to sustainably apply them in heat systems.

Learning Outcomes

The learner should be able to:

1. Deduce that different objects require different amounts of heat to change their temperatures. (u, gs, s, v/a)
2. Evaluate the concept of change of state and its implication in real life. (u, s, gs)

TOPIC 11: TRANSFER OF HEAT**DURATION: 18 Periods**

Competency: The learner investigates modes of heat transfer in nature and their application in industry and society.

Learning Outcomes

The learner should be able to:

1. Explain the mechanism of heat conduction in solids and how it applies to materials in heat systems. (u, gs, v/a)
2. Examine the significance of convection in explaining weather and climate. (u, gs, v/a)
3. Deduce that heat can be transferred in form of electromagnetic radiations and this has many real-life applications. (s, gs, v, a)

TOPIC 12: BEHAVIOUR OF GASES

DURATION: 16 Periods

Competency: The learner investigates the effect of heat on the properties of gases and their applications in the operation of different systems in the oil and gas industry.

Learning Outcomes

The learner should be able to:

1. Analyse the behaviour of ideal gasses under different conditions. (u, s, gs)
2. Evaluate the kinetic theory of gases and use it to derive the expression for the pressure exerted by the gas. (s, u, gs)
3. Modify the ideal gas equation to suit the behaviour of real gases. (u)
4. Infer that vapours exert pressure and that this has many real- life applications. (u, s, gs, v/a)

TOPIC 13: THERMODYNAMICS

DURATION: 12 Periods

Competency: The learner appreciates the behaviour of compressed gas systems in relation to their domestic and industrial applications.

Learning Outcomes

The learner should be able to:

Deduce that every system has internal energy which is a function of its temperature. (u, s)

Analyse the first law of thermodynamics and its implications in real-life situations. (u, s, gs)

SENIOR FIVE TERM 3

TOPIC 14: REFLECTION OF LIGHT

DURATION: 14 Periods

Competency: The learner investigates the light reflecting properties of different surfaces and their applications in real life.

Learning Outcomes

The learner should be able to:

1. Employ the laws of reflection of light at plane surfaces to resolve different life scenarios. (u, v/a)
2. Apply curved reflecting surfaces in real-life situations. (u, gs, v/a)

TOPIC 15: REFRACTION OF LIGHT

DURATION: 24 Periods

Competency: The learner explores the refractive properties of different materials for application in industries and medicine.

Learning Outcomes

The learner should be able to:

1. Apply the concept of refraction on plane surfaces to various situations in real life. (u, gs, v/a)
2. Analyse the concepts of critical angle and total internal reflection and their implications. (u, v/a, s, gs)
3. Apply lenses in solving a variety of problems in the community. (u, gs, v/a)

TOPIC 16: OPTICAL INSTRUMENTS

DURATION: 10 Periods

Competency: The learner explores the optical operation of different optical instruments that can be applied in a variety of fields such as medicine, military and navigation.

Learning Outcomes

The learner should be able to:

1. Explain the principle of operation of a compound microscope and their real-life applications. (u, s)
2. Describe the principle of operation of refracting telescopes and their applications. (u, s)

TOPIC 17: ELECTROSTATICS**DURATION: 24 Periods****Competency:** The learner investigates the behaviour of charges at rest and their applications in printing and energy storage in batteries.**Learning Outcomes**

The learner should be able to:

1. Apply the concept of Electrostatics in production of charge in real-life situations. (u, s, gs)
2. Appreciate the existence of a force between charges and its implications. (u,s, gs)
3. Examine electric fields and their implications in various situations. (u, s)

TOPIC 18: CAPACITORS**DURATION: 22 Periods****Competency:** The learner models capacitors for use in electronic devices.**Learning Outcomes**

The learner should be able to:

1. Appreciate that capacitors store charge and have many applications. (s, u)
2. Apply the charging and discharging processes of a capacitor in electrical and electronic devices. (u, s, gs, a/v)
3. Deduce that capacitors store energy which can be used in a variety of real-life situations. (u, s, gs)

TOPIC 19: DIGITAL ELECTRONICS**DURATION: 14 Periods****Competency:** The learner models electronic circuits using semiconductor materials and electronic devices for a variety of purposes.**Learning Outcomes**

The learner should be able to:

1. Examine the performance of semiconductor diodes in different devices. (u,s,gs)
2. Analyse the operation and application of transistors in various situations. (u,s, gs)

SENIOR SIX TERM 1

TOPIC 20: CIRCULAR MOTION

DURATION: 12 Periods

Competency: The learner examines the motion of bodies on curved paths and ensures safety precautions for people using automobiles on such paths.

Learning Outcomes

The learner should be able to:

1. Investigate the forces acting on bodies moving in circular paths and how they relate to safety. (u, s, gs, v/a)
2. Derive the expressions for motion under conical pendulum and apply them in real life. (u, s, v/a)
3. Investigate the conditions for non-skidding on banked and horizontal roads to ensure safety. (u, v/a)

TOPIC 21: SIMPLE HARMONIC MOTION

DURATION: 18 Periods

Competency: The learner investigates the behaviour of oscillating systems in order to optimise the performance of devices that employ simple harmonic motion.

Learning Outcomes

The learner should be able to:

1. Explain terminologies used in simple harmonic motion (SHM) and apply them to oscillating systems. (u, s)
2. Explore energy conservation in oscillating systems and its implications in various daily experiences. (u, s, gs)

TOPIC 22: GRAVITATION

DURATION: 20 Periods

Competency: The learner evaluates the effects of gravitation and its applications on objects both on earth and in space.

Learning Outcomes

The learner should be able to:

1. Apply the laws and principles of gravitation to real life. (u, v/a, gs)
2. Investigate the effect of gravity on bodies orbiting in space such as communication satellites and related phenomena. (u, s, gs)

TOPIC 23: PROGRESSIVE WAVES**DURATION: 24 Periods**

Competency: The learner investigates the propagation of progressive waves in matter and its application in different situations.

Learning Outcomes

The learner should be able to:

1. Deduce that waves are a means of transferring energy and that this has many applications. (u, s, gs)
2. Deduce that when waves interfere, they generate properties that have various applications in real life. (u, s, gs, v/a)
3. Explain concepts related to diffraction of waves and apply them to everyday life situations. (s, gs, v/a)
4. Examine the phenomenon of wave polarisation and how it applies to real life. (u, v/a)

TOPIC 24: STATIONARY WAVES**DURATION: 16 Periods**

Competency: The learner investigates the behaviour of stationary waves and their applications in different situations.

Learning Outcomes

The learner should be able to:

1. Analyse the behaviour of stationary waves, and the expressions that describe them. (u, s)
2. Deduce that stationary waves can be produced in pipes and strings for use in a variety of situations.
3. Illustrate the concept of resonance of waves and its applications. (u, s, v/a)

TOPIC 25: SOUND WAVES**DURATION: 20 Periods**

Competency: The learner investigates the behaviour of sound waves and their applications in different situations.

Learning Outcomes

The learner should be able to:

1. Analyse beats, notes and octaves as applied in sound, and their implications in a variety of situations. (u, s)
2. Investigate Doppler Effect and how it applies to various fields. (u, v/a)

SENIOR SIX TERM 2

TOPIC 26: CURRENT ELECTRICITY

DURATION: 20 Periods

Competency: The learner investigates electric current, its properties, transmission and uses in order to reduce power losses and improve personal and national safety.

Learning Outcomes

The learner should be able to:

1. Deduce the relationship between current, resistance and voltage, and how they relate to transmission of charges in materials. (u, s)
2. Investigate the operation of slide wire meters and apply them in a variety of situations. (s, gs, v, a)

TOPIC 27: MAGNETISM IN MATTER

DURATION: 20 Periods

Competency: The learner appreciates the magnetic properties of matter and uses them to model different useful magneto-electric devices.

Learning Outcomes

The learner should be able to:

1. Deduce that the Earth has magnetic properties and this has many implications. (u, s, gs)
2. Explain how magnetisation and demagnetisation occur in matter. (u, s)

TOPIC 28: MAGNETIC EFFECT OF AN ELECTRIC CURRENT

DURATION: 26 periods

Competency: The learner appreciates that a current carrying conductor in a magnetic field experiences a force and uses this concept to design models of different devices to solve societal needs.

Learning Outcomes

The learner should be able to:

1. Investigate the existence of a force on a current-carrying conductor in a magnetic field. (u, s, gs,)
2. Use Biot-Savart's law to write expressions for magnetic flux density in a variety of situations. (u, s, gs)
3. Explain how the force on a current-carrying conductor in a magnetic field is applied in the operation of various electrical devices. (u, s)

TOPIC 29: ELECTROMAGNETIC INDUCTION**DURATION: 18 Periods****Competency:** The learner evaluates how magnetism and current are linked and how this principle is applied in the operation of transformers and generators.**Learning Outcomes**

The learner should be able to:

1. Explain the concept of electromagnetic induction and how it is applied in a variety of situations. (u, s, gs)
2. Appreciate the concepts of self and mutual induction and their application in a variety of devices. (u, s, gs)

TOPIC 30: A.C CIRCUITS**DURATION: 24 Periods****Competency:** The learner measures a.c and investigates its behaviour in different devices.**Learning Outcomes**

The learner should be able to:

1. Explain the operation of a.c measuring devices and their various applications in real life. (u, s)
2. Evaluate the inductance, reactance and impedance of a.c circuits and their applications in real life. (u, s, gs, v/a)

SENIOR SIX TERM 3**TOPIC 31: ATOMIC PARTICLES****DURATION: 24 Periods****Competency:** The learner appreciates the structure of the atom and how the components of the atom are applied in different devices.**Learning Outcomes**

The learner should be able to:

1. Apply the Rutherford's scattering experiment to explain atomic structure. (s, u)
2. Examine the behaviour of charged particles and their applications in real life. (u, s, gs)

TOPIC 32: QUANTUM THEORY**DURATION: 24 Periods****Competency:** The learner examines how electromagnetic waves carry energy in packets and that this behaviour can be harnessed in a variety of fields.**Learning Outcomes**

The learner should be able to:

1. Explain the process of photoelectric effect and its applications in real life. (u,gs)
2. Analyse Bohr's model and how it is used to explain atomic spectra of different elements. (u, s, gs)
3. Deduce that when fast moving electrons are stopped by matter, they produce energetic radiations which have many applications. (u, s, gs, v/a)

TOPIC 33: NUCLEAR PROCESSES**DURATION: 24 Periods****Competency:** The learner appreciates that nuclear reactions involve high amounts of energy which can be both constructive and destructive.**Learning Outcomes**

The learner should be able to:

1. Appreciate that nuclear reactions generate energy which can be harnessed for different purposes. (u, s, v/a)
2. Deduce that nuclides disintegrate emitting particles and energy which have a variety of applications. (u, s, gs, v/a)

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