LEARNING CONTENTS AND STUDENTS' LEARNING OUTCOMES GRADE IX

Contents:	**Students' Learning Outcomes**	**R**	**U**	**Ap.**	**An.**	**E**	**C**
Part-I(Mechanics)	Students will be able to:						
Unit # 1: Physical Quantities And Measurement (21 Periods)							
1. Introduction to Physics	• Describe the role of different branches of Physics in Science, Technology and Society.		*				
2. Physical Quantities	• Differentiate between base and derived physical quantities.				*		
3. International System of Units	• List the seven units of System International (SI) along with their symbols and physical quantities (standard definitions of SI units are not required).		*				
4. Prefixes (Multiples and sub multiples)	• Interconvert the prefixes and their symbols to indicate multiples and sub multiples for both base and derived units.			*			
5. Standard Form / Scientific Notation	• Write the answer in scientific notation in measurements and calculations.			*			
6. Measuring Instruments: a. Vernier Callipers b. Screw Gauge c. Physical Balance d. Stopwatch	• Identify and explain the limitation of measuring instruments such as Metre Rule. • Describe the working of Vernier Callipers and Screw Gauge for measuring length and their limitations.		* *				

7. An Introduction to Significant Figures	Describe the need using significant figures for recording and stating results in the laboratory.		*				
Investigation Skills:							
	• Compare the least count of the following measuring instruments and state their measuring range: i. Measuring Tape ii. Metre Rule iii. VernierCallipers iv. Micrometer Screw Gauge				*		
	• Make a paper scale of given least count e.g. 0.2 cm and 0.5 cm.			*			
	• Measure the length and diameter of a cylinder and calculate the volume with a vernier callipers.			*			
	• Measure the thickness of a metal strip or a wire using a Screw Gauge.			*			
	• Determine an interval of time using Stopwatch.			*			
	• Determine the mass of an object by using different types of balances and identify the one which gives most precise measurement.			*			
	• Determine volume of an irregular shaped object using a measuring cylinder.			*			

	• List laboratory safety equipment rules and appropriate use of these equipments in the laboratory.			*			
Science, Technology and Society Connections:							
	• Determine length, mass and time in daily life activities using various measuring instruments.			*			
UNIT # 2 KINEMATICS (19 Periods)							
1. Rest and Motion	• Describe using examples that rest and motion are relative.		*				
2. Types of Motion (Translatory, Rotatory, Vibratory)	• Identify different types of motion i.e., translatory (Linear, Random and Circular); rotatory and vibratory motions and distinguish among them.			*			
3. Terms associated with Motion; • Position • Distance and Displacement • Speed and Velocity • Acceleration	• Define the term speed, velocity and acceleration. • Differentiate with examples between distance and displacement, speed and velocity	*			*		
4. Scalars and Vectors	• Differentiate with examples between scalar and vector quantities. • Represent vector quantities by drawing lines according to scale.				*		

					*		
5. Graphical Analysis of Motion; • Distance-Time Graph • Speed-Time Graph	• Plot and interpret Distance-Time graph and Speed-Time graph. • Determine and interpret the slope of Distance-Time and Speed-Time graphs. o Determine from the shape of the graph, the state of a body, when the body is: • At rest • Moving with constant speed • Moving with variable speed. • Calculate the area under Speed-Time graph to determine the distance travelled by the moving body.				* *		
6. Equations of Motion; (a) For Uniform Velocity • $S = vt$ (b) For Uniformly Accelerated Motion • $v_f = v_i + \boldsymbol{a}\, t$ • $S = v_i t + ½\, \boldsymbol{a}\, t^2$ • $v_f^2 - v_i^2 = 2\, \boldsymbol{a}\, S$	• Derive equations of motion for a body moving with a uniform acceleration in a straight line using graph. • Solve problems related to uniformly accelerated motion using appropriate equations.			*			

7. Motion due to Gravity	• Solve problems related to freely falling bodies using 10 ms^{-2} as the acceleration due to gravity			*			
Investigation Skills:							
	• Demonstrate various types of motion so as to distinguish between translator, rotatory and vibratory motions. • Determine the acceleration of free-fall by timing a falling object by Free Fall Apparatus. • Calculate acceleration of an iron ball rolling down an inclined surface using angle iron by drawing graph between $2S$ and t^2 .			* * *			
Science, Technology and Society Connections							
	• Measure the average speed of a 100 m sprinter. • Use mathematical slopes (ramps) of graphs or straight lines in real life applications. • Interpret graph from newspapers, magazines regarding cricket and weather etc.			* * *			
UNIT # 3 DYNAMICS (21 Periods)							
1.Momentum	• Explain inertia, momentum and force and describe that force is the rate of change of momentum.		*				

2.Newton's Laws of Motion	• State and explain Newton's laws of motion. • Distinguish between mass and weight and solve problems using $F = ma$, and $w = mg$. • Calculate tension and acceleration in a string during motion of bodies connected by the string and passing over frictionless pulley using second law of motion. • State the law of conversation of momentum and apply it to a system of two objects.	* *		* * 			
3.Types of Friction	• Define friction and explain the effect of friction on the motion of a vehicle in the context of tire surface, road conditions including skidding, braking force. • Describe what may happen if all frictions suddenly disappear. • Demonstrate that rolling friction is much lesser than sliding friction.	*	* 	 *			
4.Uniform Circular Motion	• Explain that motion in a curved path is due to a force perpendicular to the velocity of a body. • Define centripetal force and calculate centripetal force on a body moving in a circle using the equation $F = mv^2/r$.		* *				
Investigation Skills:	•						
	• Identify the relationship between load and friction by sliding a trolley carrying different loads with the help of a spring balance on different surfaces.			*			

	• Determine the value of "*g*" by Atwood's machine.			*			
	• Investigate the relationship between force of limiting friction and normal reaction to find the coefficient of sliding friction between a wooden block and horizontal surface.			*			
	• Determine the force of limiting friction by rolling a roller on a horizontal plane.			*			
Science, Technology and Society Connections:							
	• Identify the principle of dynamics with reference to the motion of objects and vehicles (e.g. analyze the throwing of a ball, swimming, boating and rocket motion).			*			
	• Identify the safety devices (such as packaging of fragile objects, the action of crumple zones and seatbelts) utilized to reduce the effects of changing momentum.			*			
	• State what will happen to you while you are sitting inside a bus and when the bus: • starts moving suddenly • stops moving suddenly • Turns a corner to the left suddenly	*					
	• Identify the use of centripetal force in:			*			

	• safe driving by banking roads • washing machine dryer • Cream separator.						
UNIT # 4 TURNING EFFECT OF FORCES (20 Periods)							
1. Forces on Bodies	• Define like and unlike parallel forces.	*					
2. Addition of Forces	• State head to tail rule of vector addition of forces / vectors.	*					
3. Resolution of Forces	• Describe how a force is resolved into its perpendicular components. • Determine the magnitude and direction of a force from its perpendicular components.		*	*			
4. Moment of a Force	• Define moment of force or torque as; • Moment = force x perpendicular distance from pivot to the line of action of force • Explain the turning effect of force by relating it to everyday life.	*	*				
5. Principle of Moments	• State the principle of moments.	*					
6. Centre of Mass	○ Define the centre of mass and centre of gravity of a body.	*					
7. Couple	○ Define couple as a pair of forces tending to produce rotation.	*					

8. Equilibrium	○ Define equilibrium and state the two conditions for equilibrium of a body. ○ Solve problems on simple balanced systems when bodies are supported by one pivot only. ○ Describe the states of equilibrium and classify them with common examples.	*	*	*			
9. Stability	○ Explain effect of the position of the centre of gravity on the stability of simple objects.		*				
Investigation Skills:							
	• Determine the position of center of gravity of regular and irregular shaped objects.			*			
	• Verify the principle of moments by using a metre rod balanced on a wedge.			*			
	• Determine the tension in strings by balancing a metre rod on two stands.			*			
	• Determine the weight of an unknown object by using vector addition of forces.			*			
	• Determine the weight of an unknown object by using principle of moments.			*			

Science, Technology and Society Connections:							
	• Illustrate by describing a practical application of moment of force in the working of bottle opener, spanner, door/window handles, see-saw etc.			*			
	• Demonstrate the role of couple in the steering wheels and bicycle pedals.			*			
	• Demonstrate through a balancing toy, racing car etc. That the stability of an object can be improved by lowering the centre of mass and increasing the base area of the objects.			*			
Unit # 5 Gravitation (16 periods)							
1. Law of gravitation	• State newton's law of gravitation. • Explain that the gravitational forces are consistent with newton's third law. • Explain gravitational field as an example of field of force	*	* *				
2. Measurement of mass of earth	• Define weight . • Calculate the mass of earth by using law of gravitation. • Solve problems using newton's law of gravitation.	*		* *			
3. ariation of "*g*" with altitude	• Explain that value of "*g*" decreases with altitude from the surface of earth.		*				

4. Motion of artificial satellites	• Discuss the importance of newton's law of gravitation in understanding the motion of satellites.		*				
Investigation Skills:							
	• Determine the value of "*g*" using simple pendulum.			*			
Science, Technology and Society Connections:							
	• Gather information to predict the value of the gravitational field strength "*g*" at the surface of any planet or moon using newton's law of gravitation					*	
• **unit # 6 Work and Energy (20 periods)**							
1. Work	• Define work and its si unit. • Calculate work done using equation work = force × distance moved in the direction of force.	*		*			
2. Kinetic energy and potential energy	• Prove that kinetic energy $e_k = ½ mv^2$ and potential energy $e_p = mgh$ and solve problems using these equations			*			
3. Efficiency	• Define efficiency of a working system and calculate the efficiency of an energy conversion using the formula; efficiency = energy converted into the required form / total energy input • Explain why a system cannot have an efficiency of 100%.	*	*				

4. Power	• Define power, its si unit and calculate power from the formula o power = work done / time taken	*					
5. Forms of energy and its major sources	• List the different forms of energy with examples.			*			
	• Describe the processes by which energy is converted from one form to another with reference to: • Fossil fuel energy • Hydroelectric generation • Solar energy • Nuclear energy • Geothermal energy • Wind energy • Biomass energy		*				
	• Differentiate energy sources as non renewable and renewable energy sources with examples of each.				*		
Investigation Skills:							
	• Investigate conservation of energy of a ball rolling down an inclined plane using double inclined plane and construct a hypothesis to explain the observation.			*			
	• Compare personal power developed for running up stairs versus walking up stairs using a stopwatch.				*		

Science, Technology and Society Connections:							
	• Analyze using their or given criteria, the economic, social and environmental impact of various energy sources e.g. Fossil fuel, wind, falling water, solar, biomass, nuclear, thermal energy and its transfer (heat).				*		
	• Analyze and explain improvements in sports performance using principles and concepts related to work, kinetic energy and potential energy and law of conservation of energy (e.g. Explain the importance of the initial kinetic energy of a pole vaulter or high jumper).				*		
	• Search library or internet and compare the efficiencies of energy conversion devices by comparing energy input and useful energy output.					*	
	• Explain principle of conservation of energy and apply this principle to explain the conversion of energy from one form to the other such as a motor, a dynamo, a freely falling body, a photo cell and a battery.		*				
	• List the efficient use of energy in the context of the home, heating and cooling of buildings and transportation.		*				
Unit # 7 Properties of Matter (23 periods)							

1. Kinetic molecular model of matter	• State kinetic molecular model of matter (solid, liquid and gas forms). • Describe briefly the fourth state of matter i.e. "plasma".	*	*				
2. Density	• Define the term density and compare the densities of solids, liquids and gases.	*					
3. Pressure	• Define the term pressure, give examples and explain how it varies with force and area in the context of everyday examples. • State pascal's law and describe its applications.	* *					
4. Pressure in liquids	• State relation for pressure beneath a liquid surface to depth and density i.e., (p=ρgh) and solve problems using this equation.	*					
5. Upthrust	• State archimedes principle and determine the density of an object using this principle.	*					
	• State the upthrust exerted by a fluid on a body.	*					
	• Explain principle of floatation.		*				
6. Atmospheric pressure	• Explain atmospheric pressure and its variation with height considering air column over a certain area as fluid. • Describe how the height of a liquid column may be used to measure the atmospheric pressure		* *				
7. Elasticity	• State hooke's law and explain elastic limit.	*					
8. Stress, strain and young's modulus	• Define the terms stress, strain and young's modulus.	*					

Investigation Skills:							
	• Measure the atmospheric pressure by fortin's barometer or aneroid barometer.			*			
	• Measure the pressure of motor bike / car tyre and state the basic principle of the instrument and its value in si units.			*			
	• Determine the density of irregular shaped objects.			*			
	• Determine the density of a liquid using a syringe.			*			
Science, Technology and Society Connections:							
	• Determine the density of a solid and of a liquid using Archimedes principle.			*			
	• Explain that ships and submarines float on sea surface when the up thrust acting on them balances their total weight		*				
	• Recognize that hydraulic press, hydraulic car lift and hydraulic brakes in daily life work on Pascal's law			*			
	• Explain that the action of sucking through a straw, dropper, syringe and vacuum cleaner is due to atmospheric pressure		*				
	• Explain the use of hydrometer to measure the density of various liquids.		*				
	• Investigate the relationship between applied force and extension using helical spring by plotting a graph and determine the value of the spring constant.			*			

Section 2 Heat							
Unit # 8 Thermal Properties of matter (22 periods)							
1. Temperature and heat	• Define temperature as quantity which determine the direction of flow of thermal energy. • Define heat as the energy transferred resulting from the temperature difference between two objects.	* *					
2. Thermometer	• List basic thermometric properties for a material to construct a thermometer.		*				
	• Convert the temperature from one scale to another i.e. Fahrenheit, celsius and kelvin scales and solve related numerical problems.			*			
	• Describe rise in temperature of a body in term of an increase in its internal energy.		*				
3. Specific heat capacity	• Define the terms heat capacity and specific heat capacity.	*					
4. Latent heat of fusion	• Describe heat of fusion and heat of vaporization as energy transfer without a change of temperature for change of state.		*				

5. Latent heat of vaporization	• Describe experiments to determine heat of fusion and heat of vaporization of ice and water respectively by sketching temperature-time graph on heating ice.		*				
6. Evaporation	• Explain the process of evaporation and the difference between boiling and evaporation. • Explain that evaporation causes cooling.		*				
	• List the factors which influence evaporation.		*				
7. Thermal expansion	• Describe quantitatively the thermal expansion of solids (linear and volumetric expansion) and solve related numerical problems.		*				
	• Explain the thermal expansion of liquids (real and apparent expansion).		*				
Investigation Skills:							
	• Determine the melting point of ice by drawing temperature-time graph on heating • Determine the boiling point of water by drawing temperature-time graph on heating. • Measure the specific heat of a solid substance by method of mixture using polystyrene cup as calorimeter. • Determine the specific heat of fusion of ice. • Demonstrate that evaporation causes cooling.			* * * * *			
Science, Technology And Society Connections:							

	• Explain that the bimetallic strip used in thermostat is based on different rate of expansion of different metals on heating.		*				
	• Describe one everyday effect due to relatively large specific heat of water.		*				
	• Describe the use of cooling caused by evaporation in perspiration, clay pitcher and refrigeration.		*				
Unit # 9 Transfer of Heat (18 periods)							
1. Three processes of heat transfer a. Conduction b. Convection c.Thermal radiation	• Describe in terms of molecules and electrons, how heat transfer occurs in solids. • State the factors affecting the transfer of heat through solid conductors and hence, define the term "thermal conductivity". • Explain how insulation reduces energy transfer by conduction. • Explain the convection currents in fluids due to difference in density. • Describe the process of radiation from all objects.	* * 	* * *				
2. Thermal conductivity	• Solve problems based on thermal conductivity of solid conductors. • Explain that energy transfer of a body by radiation does not require a material medium and rate of energy transfer is affected by: i. Colour and texture of the surface ii. Surface temperature iii. Surface area		*	*			

3. Everyday applications of heat transfer	• Explain the role of radiation in greenhouse effect and its effect on global warming. • Explain how birds can glide in the air for hours.	* *					
Investigation Skills:							
	• Describe convection in water heating by putting a few pinky crystals in a round bottom flask. • Explain that water is a poor conductor of heat.	* *					
	• Investigate the absorption of radiation by a black surface and silvery surfaces using leslie cube. • Investigate the emission of radiation by a black surface and silvery surfaces using leslie cube.			* *			
Science, Technology And Society Connections:							
	• Describe the use of cooking utensils, electric kettle, air conditioner, refrigerator cavity wall insulation, vacuum flask and household hot water system as a consequence of heat transmission processes. • Explain convection in sea water to support marine life. • Describe the role of land breeze and sea breeze for moderate costal climate. • Describe the role of convection in space heating.		* * *				

	• Identify and explain some of the everyday applications and consequences of heat transfer by conduction, convection and radiation. • Explain how the birds are able to soar for hours without flapping their wings and glider is able to rise by riding on thermal currents which are streams of hot air rising in the sky.		* *				