Physics Syllabus
For
Grade 11

Grade 11 physics objectives

After completing grade11 physics lessons students will be able to:

- Understand the basic concepts of measurement and practical work, vector quantities, kinematics, dynamics, the law of conservation of energy, and the way energy is transformed and transmitted, the concepts and units related to energy, work, and power and the laws of conservation of momentum for objects moving in one and two dimensions ,properties of bulk matter
- Develop manipulative skills in solving problems related to kinematical and dynamical problems related to translational and rotational motions ,the laws of conservation of momentum and energy
- Develop scientific-inquiry skills as they verify accepted laws and solve both assigned problems and those emerging from their investigations.
- Analyze the interrelationships between physics and technology, and consider the impact of technological applications of physics on society and the environment.
- solve the problems using a variety of problem-solving skills;

Unit 1: Measurement and practical work *(8 periods)*

***Unit outcomes*:** Students will be able to:

- demonstrate knowledge and understandings in the science of measurement, errors in measurement
- Develop skills in experimenting and report writing
- Understand a systematic and random errors in the measurement of a physical quantity
- communicate the procedures and results of investigations and research for specific purposes using data tables, laboratory reports, and account for discrepancies between theoretical and experimental values with reference to experimental uncertainty
- express the result of any calculation involving experimental data to the appropriate number of decimal places or significant figures
- Identify and describe science- and technology-based careers related to the subject area under study
- select and use appropriate SI units (units of measurement of the International System of Units.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • Explain the importance of measurement • identify and use appropriate units for data that will be collected • Distinguish between random error and systematic error • State the uncertainty in a single measurement of a quantity • Describe sources of errors • Identify types of errors • identify the orders of magnitude that will be appropriate and the uncertainty that may be present in the measurement of data • Distinguish between random uncertainties and	***1. Measurement & practical work*** **Science of measurement** *(1 period)* • Importance of measurement • Units of measurements **Errors in measurement** *(2 periods)* • Uncertainty in measurement • Sources of errors • Types of errors **Precision Accuracy and Significance** *(3 periods)* • Accepted and measured value • Order of magnitude • Calculating errors	The purposes of this unit are to introduce measurement, precision and accuracy as well as reporting experimental results. Initiate discussion on what measurement is and what it is not. Distinguish between different types of errors. Illustrate significant digits using actual measurements. Students should be taught to estimate the last digit rather than to ignore it. Calculators provide more digits than are significant, especially when performing multiplication and division. If students recognize this and report the correct number then the major objective of this unit is achieved. Let the students measure different quantities (length, mass, time, current etc.) and repeatedly or by many students, calculate the average. • Appropriate calculations on errors • Let the students say something on how error in measurement arises. After listening to their response, give an explanation on measurement and uncertainty.The point is that error is attributed to a process, not the individual. Measurements in science are conducted many times, sometimes hundreds, to get accurate values. Activity: students will make a measurement of an object: say the volume of a box, or the volume of a soccer ball. • Assist students in becoming familiar with metric units by identifying various units with parts of human body. Approximately 1 cm is width of small fingernail; 1m is "reach' from tip of chin to tip of outstretched hand. Substitution of units in equations in algebra will provide preliminary check on correctness of equation format. • Show glass beakers of various sizes up to 1 liter. Use food coloring in water to improve visibility .Also show several common liquid measures and ask students to estimate volumes in SI units' .Have students bring cardboard box from grocery sore for which they have calculated volume in liters.

Competencies	***Contents***	***Suggested Activities***
systematic errors • distinguish between precision and accuracy • state what is meant by the degree of precision of a measuring instrument • Describe what is meant by the term significant digit and how it is related to precision • Identify rules concerning the number of significant digits that a numeral has • Define the term scientific method • State the steps of scientific methods • Describe the procedures of report writing • uses terminology and reporting styles appropriately and successfully to communicate information and understanding • Present information in tabular, graphical, written and diagrammatic form. • report concisely on	• Precision and accuracy • Scientific notation • Operations with significant figures **Experiment and Report Writing** *(2 periods)* • Scientific method of conducting an experiment • Report writing	• Measure precisely 100 cc alcohol (ethanol) and pour into graduated cylinder. Add precisely 100 cc of water and observe final volume is not 200 cc! Discuss conservation of mass vs volume. • Teachers need to make sure students use the correct units when solving physics problems. If a problem presents information about a quantity like time in different units, they need to convert that information to the same units. You convert units by: 1. Knowing the conversion factor (say, 12 inches to a foot; 2.54 centimeters to an inch). 2. Multiplying by the conversion factor (such as 3.28 feet/1.00 meter) so that you cancel units in both the numerator and denominator. For example, to convert meters to feet, you multiply by 3.28 ft/m so that the meter units cancel. In conversions, it is easy to make mistakes so it is good to check your work. To make sure you are applying conversions correctly, make sure the appropriate units cancel. To do this, you note the units associated with each value and each conversion factor.

Competencies	***Contents***	***Suggested Activities***
experimental procedures and results • Use scientific calculators efficiently		

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms precision, uncertainity, error, magnitude of order; state the types of errors, distinguish between random and systematic error, use the appropriate units for the given measurements, convert from one units of measurements to another, describe the procedures of report writing of the experiment, state the uncertainty in a single measurement of a quantity Explain the importance of measurement in life., explain about sources of errors and their types, differentiate between accepted and experimental values, add and subtract scientific notation, keeping significant figures properly, Multiply scientific figures keeping significant figures properly., Define the term scientific method and State the steps of scientific methods, Explain the possible sources of errors.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 2: Vector quantities *(18 periods)*

***Unit outcomes*:** Students will be able to:

- Familiarize themselves with basic principles of operations of vectors
- acquire knowledge and understandings in nature, and properties of vectors
- apply the knowledge of vectors in interpreting physical phenomena
- develop skills in using vector concepts in the solution of problems
- analyze experimental data, using vectors, graphs, trigonometry, and the resolution of vectors into perpendicular components, to determine the net force acting on an object and its resulting motion;
- Appreciate the use of vector algebra in treating physical concepts.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • demonstrate an understanding of the difference between scalars and vectors and give common examples • add vectors by graphical representation to determine a resultant • explain what a position vector is • use vector notation and arrow representation of a vector • specify the unit vector in the direction of a given vector • add/subtract two or more vectors by the vector addition rule • determine the magnitude and direction of the resolution of two or more vectors using Pythagoras	***2. Vector quantities*** Definition of vectors. **Types of vectors** *(3 periods)* **Position vector** **unit vectors** **collinear and coplanar vectors** **Resolution of Vectors into rectangular components** *(2 periods)* **Vector addition and Subtraction** *(7 periods)* **graphical methods** **Analytic methods (Triangle and Parallelogram laws)** **Component method** **Multiplication of vectors** *(6 periods)*	There are many practical examples of vector addition, and several should be discussed in class. Some of these include the motion of a boat in water, an airplane in wind, and a sled in snow. Statics, the equilibrium condition of point objects, also has many common examples. The need for vector, rather than scalar, addition of forces is best displayed by means of a demonstration. • Use arrows, drawn to scale, "heads to tail" to show triangle law (i.e. the resultant of two vectors completes the triangle formed by the two). • Commutative law of vector addition can be demonstrated by producing same resultant when varying order of vector addition. • Help students to show how three non-zero vectors can be added up to be zero. Draw an example • Appropriate Calculations **Experiments** Find resultants using Newton balances or pulleys. **Project Work(s)** Investigation of the laws of equilibrium for a set of co-planar forces

Competencies	***Contents***	***Suggested Activities***
theorem and trigonometry • use the geometric definition of the scalar product to calculate the scalar product of two given vectors • use the scalar product to determine projection of a vector onto another vector • test two given vectors for orthogonality • use the vector product to test for collinear vectors • Explain the use of knowledge of vector in understanding natural phenomenon	**Multiplication of vector by a scalar** **2.4.2. Scalar product** **2.4.3. Vector product** ***2.4.4.*** **Application of vectors**	

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: give the definitions of the terms: position vector. Unit vectors. collinear, coplanar, non-coplanar vectors; add and subtract vectors by using graphical and analytical methods, use the triangle and parallelogram law of addition of vectors, define the scalar and vector product of vectors, apply the definitions of vector products to find the result of two or more vectors, resolve vectors into their rectangular components and along any given line, explain some of the applications of vectors. Distinguish between vector and scalar quantities, and give examples of each,**-** Determine the resolved part of a vector in any given direction, add vectors by graphical representation to determine a resultant, determine graphically a resultant of two vectors, add/subtract two or more vectors by the vector addition rule, solve problems related to scalar and vector products of two vectors in a plane, explain properties of vector operations.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 3: Kinematics *(20 periods)*

***Unit outcomes*:** Students will be able to:

- Gain an understanding of the fundamental principles of kinematics in one and two dimensions
- Develop skills in applying equations of motions to solve practical problems
- Recognize the effect of air resistance and force of gravity on motion of a body in a plane
- analyze the motion of objects in horizontal, vertical, and inclined planes, and predict parameters of the motion
- investigate motion in a plane, through experiments,
- analyze and solve Problems involving the forces acting on an object in linear, projectile, and circular motion, With the aid of vectors, graphs, and free-body diagrams;
- Describe technological advances related to motion; and identify the effects of societal influences on transportation and safety issues.

Competencies	***Contents***	***Suggested Activities***
Students will be able to: • describe motion using vector analysis • Define the term reference frame • Explain the difference between average speed (velocities) and instantaneous speed (velocity) • Solve numerical problem involving average velocity and instantaneous velocity • Define instantaneous acceleration • Solve problems involving average and instantaneous acceleration	***3. Kinematics*** **3.1. Motion in a Straight Line** *(10 periods)* **3.1.1. Frame of reference** • Position vector • Displacement vector **3.1.2. Average and instantaneous velocity** **3.1.3. Average and instantaneous acceleration**	The content and approach to problem solving in this section are fundamental in the study of physics. Encourage students to develop the habit of selecting the fundamental equation, solve for the unknown before substituting any numerical value and dimensional checks as necessary. The section on Motion in a plane extends the concepts of linear motion to curvilinear motion. Activities should help students recognize that the motion of projectiles is the result of an object having linear motions in two directions at the same time. The Concept of the independence of the velocities, in the two directions, gives students considerable difficulty. One of the simplest and most effective means of demonstration the independence of velocities involves the use of a flexible ruler and two marbles or steel balls. Both balls, when flipped with the ruler, will leave the edge of the table at the same time. If students listen carefully, they will hear only one "click" as both balls strike the floor simultaneously Demonstration: A long ramp along one side of a class room can be used to illustrate accelerated motion. Distance traveled at the end of equal intervals of time can be marked with chalk. The acceleration equations should then be demonstrated by plotting distance versus time, and distance versus $(time)^2$. • Galileo's thought experiment that compares the time of two balls falling separately or tied together can be used to support the idea that acceleration due to gravity is constant. • "Monkey and Hunter" demonstration gives a more elaborate method of demonstrating the independence of velocities. • Measurement of velocity and acceleration • Measurement of g. • Investigation of relationship between period and length for a simple pendulum and

Competencies	*Contents*	*Suggested Activities*
• Solve quantitative and qualitative kinematics problems related to average and instantaneous velocity and acceleration • Derive equations of motion for uniformly accelerated motion • Apply equations of uniformly accelerated motion in solving problems • Draw graphs from the kinematics equations • Interpret s-t, v-t and a-t graphs • solve numerical kinematics problems • relate scientific concepts to issues in every day life • explain the science of kinematics underlying familiar facts, observations, and related phenomena • Describe the conditions at which falling bodies attain their terminal velocity	**3.1.4. Motion with constant acceleration** **3.1.5. Graphical representation of motion** **3.1.6. Freely falling bodies** • Terminal velocity	calculation of g. hence

Competencies	***Contents***	***Suggested Activities***
• analyze and predict, in quantitative terms, and explain the motion of a projectile with respect to the horizontal and vertical components of its motion; • Derive equations related to projectile motion • Apply equations to solve problems related projectile motion	**3.2. Motion in a Plane** *(10 periods)* **3.2.1. Projectile Motion**	• Use ruler at edge of a table, with pencil as a pivot, to cause one coin to drop vertically while other coin is propelled horizontally. Both hit level floor simultaneously showing time of fall is independent of any horizontal motion. Test by changing height of fall and initial horizontal velocity • Use knife to punch two holes on opposite sides of Styrofoam cup near bottom. Fill with water and drop from height of several meters. .During free fall, in accelerated frame of cup, water exerts no weight on cup; hence no pressure and stream ceases. • Let students act out motions represented on graphs .practice until they can do this without any pauses that are not shown on the graph. When they are able to execute the motions let them explain how they knew to move as they did • Stress the fact that the object is speeding up if the velocity and acceleration have the same sign, whether positive or negative. If the velocity and acceleration have different signs, then the object is slowing down. Negative acceleration does not necessarily mean slowing down. Positive acceleration does not necessarily mean speeding up. • Students often confuse a graph of motion with the trajectory of an object (e.g., a thrown ball) when viewing distance vs. time graphs. They are not the same thing. The path of an object moving through space can look completely different from a plot of the object's motion over time. For example, the trajectory of a coin tossed straight up in the air looks very different from a graph of its motion. A graph that plots variables such as money vs. time is not so confusing because there is no motion involved—there is only a variable changing over time. To break the habit of associating the path of the motion with the graph of the motion, it is helpful to ask students to compare distance vs. time graphs with similar graphs that represent entirely different situations.
• Define centripetal force and centripetal acceleration • identify circular motion requires the application of a constant force directed toward the center of the circle • Distinguish between uniform and non-uniform circular motion	**3.2.2. Uniform Circular Motion** **3.2.3. Motion in a vertical Circle** • Tangential and radial acceleration	
• Analyze the motion of a satellite • Identify satellites are projectiles that fall	**3.2.4. Motion of a Satellite**	

Competencies	*Contents*	*Suggested Activities*
around the earth • analyze and predict, in quantitative terms, and explain uniform circular motion in the horizontal and vertical planes with reference to the forces involved • describe Newton's law of universal gravitation, apply it quantitatively, and use it to explain planetary and satellite motion • Determine the relative velocities of bodies moving at an angle relative to each other • Use the relative velocity equation to convert from one measurement to the other in reference frames in relative motion	**3.2.5. Relative Velocity** • Relative velocity in one dimension • Relative velocity in two dimension	

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms reference frame, average velocity, instantaneous velocity. average acceleration ,instantaneous acceleration, projectiles, relative velocity, uniform circular motion, radial force; derive kinematics equations and apply them to solve numerical problems, describe the motion of freely falling bodies, motion of satellites and motion of a body in horizontal and vertical circles, describe Newton's law of universal gravitation and use it to explain planetary and satellite motion, interpret graphs, draw graphs from the kinematical equations, derive equations for maximum height, range and total time of flight of a projectile, determine the relative velocities of bodies moving at an angle relative to each other, explain the difference between average speed(or velocity)and instantaneous speed(or velocity), solve numerical problems involving average velocity, instantaneous velocity and acceleration, explain uniform circular motion in the horizontal and vertical planes with reference to the forces involved, explain uniform circular motion in the horizontal and vertical planes with reference to the forces involved, identify circular motion requires the application of a constant force directed toward the center of the circle,**-** solve problems involving objects moving in two dimensions, describe the behavior of motion of a freely falling body.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 4: Dynamics *(20 periods)*

***Unit outcomes*: Students will be able to:**

- Realize that momentum is an inherent property of moving objects
- demonstrate an understanding of the relationship between net force and the acceleration of an object in linear motion
- Analyze the effect of a net force in quantitative terms, using graphs, free-body diagrams, and vector diagrams
- describe the contributions of Galileo and Newton to the understanding of dynamics
- Describe technological advances related to motion; and identify the effects of societal influences on transportation and safety issues.
- analyze ways in which an understanding of the dynamics of motion relates to the development and use of technological devices.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • Define the term dynamics • Identify the four basic forces in nature • define and describe the concepts and units related to force, coefficients of friction, torque, and work; • Use the laws of dynamics in solving problems • Interpret Newton's laws and apply these to moving objects • explain the conditions associated with the movement of objects at constant velocity • State Newton's universal law of gravitation • describe how Newton's laws of motion and his law of universal gravitation explain the phenomenon of gravity and necessary conditions	***4. Dynamics*** **4.1. The force concept** *(1 period)* **4.2. Basic laws of Dynamics** *(3 periods)* • **Newton's laws of motion** • **Frictional forces** • **Newton's universal law of gravitation**	The simplicity of Newton's laws makes them difficult for students to appreciate. Students must understand that Newton's laws govern all motion. Emphasize that the result of a net force is the acceleration of a body, and if no net force exists, the body will remain in equilibrium. Equilibrium includes moving with constant velocity. Momentum and energy conservation are concepts that are equivalent to Newton's laws, but are more powerful and at the same time, more abstract. Forces can be felt and acceleration can be measured; momentum and energy must be calculated. Citing collisions as sources of information in atomic and nuclear physics may be used to motivate students to take the content with increased interest. Most of the information known about the atomic nucleus is interpretation of collisions between subatomic particles since the famous Rutherford's alpha-scattering experiment. **Experiments** 1. Determine static and kinetic friction by method of sliding block along an inclined surface • Demonstration of the Newton's laws using air track or tickertape timer or powder track timer, etc. If air track is unavailable a steel ball rolling across a smooth table has low enough friction to be useful as well. • If available an air track or dynamics cart can be used to demonstrate collisions. Else billiard balls serve very well to qualitatively observe collision between balls of equal or different masses. .

Competencies	***Contents***	***Suggested Activities***
of "weightlessness" • define, and when appropriate give examples of, such concepts gravity, Newton's law of universal gravitation		Activity: determination of coefficient of friction between a given pair of surfaces Let student standing on floor throws a ball filled with sand to demonstrator on cart. Ball provides momentum exchange .construct carts using plywood about 60x 100cm with hard ball bearing wheels. Persons on two carts play toss with sand jug, each receiving a reaction as result of throwing jug (action).Can also push on one another with flat outstretched palms to illustrate 3rd law. Show 2nd law by placing two persons on one cart and one another cart. Shows different accelerations for same force. Discuss other 3rd law examples including rockets, being careful to ask on what and where reaction force acts .
• analyze, in qualitative and quantitative terms, the various forces acting on an object in a variety of situations, and describe the resulting motion of the object • solve dynamics problems involving friction		• Kneel on table with forearms flat on table and elbows touching knees. Place short object such cigarette lighter at tips of outstretched fingers. Now place hands behind back and try to tip over object with nose without losing balance. Most women can, most men cannot because mass distribution for most men places in shoulder area, which shifts center of mass forward of knees. **Project Work(s)** 1. Group discussion on Applications and presentation (seat belts, rocket travel, Sports, all ball games, Importance of friction in everyday experience, e.g. walking, use of lubricants, etc.)
• Describe the terms momentum and impulse • State the law of conservation of linear momentum • Discover the relationship between impulse and momentum, according to Newton's 2nd law • Apply quantitatively the law of conservation of linear momentum	**4.3 Law of conservation of Linear Momentum and its applications** *(5 periods*	
• Distinguish between elastic and inelastic collision • Describe head-on collision • Describe glancing	**4.4 Elastic and inelastic collisions in one and two dimensions** *(3 periods)* • Collision in one	

Competencies	*Contents*	*Suggested Activities*
collision • Describe center of mass of a body • Determine the position of center of mass of a body • Describe explosion and rocket propulsion in relation to momentum conservation • Describe kepler's laws • Describe the motion of stationary satellite • Use Kepler's law to solve problems	dimension (head-on) • Collision in two dimension (glancing) **4.5 Center of mass** *(2 periods)* **4.6 Momentum conservation in variable mass system (rocket propulsion, explosion….)** *(3 periods)* • Explosion and rocket propulsion **4.7 Dynamics of uniform circular motion *(Banked curves)*** *(3 periods)* • Kepler's laws of planetary motion • Orbital velocity and escape velocity • Geosynchronous or stationary satellite	

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level
A student working at the minimum requirement level will be able to: define the terms; dynamics, linear momentum, elastic and inelastic collision and center of mass; state the laws of dynamics, the law of conservation of momentum; solve problems involving the basic laws of dynamics, momentum conservation and dynamics of circular motion. use Newton's laws, state Newton's 2nd law interims of momentum, apply Newton's laws of motion to explain and predict the behavior of bodies acted by external forces, use the principle of momentum conservation, explain qualitatively how frictional forces depend on the nature of surfaces and normal contact force, use free body diagram representing forces on a point mass to solve problems, solve numerical problems involving Newton's laws of motion, determine the forces needed to keep an object moving in a horizontal and vertical circles, define the centre of mass of a body and that of a system of particles.

Students above minimum requirement level
Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level
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Unit 5: Work, energy and power *(13 periods)*

***Unit outcomes*:** Students will be able to:

- demonstrate an understanding, in qualitative and quantitative terms, of the concepts of work, energy , energy transformations and power
- design and carry out experiments and solve problems involving energy transformations and the law of conservation of energy.
- analyze the costs and benefits of various energy sources and energy-transformation technologies that are used around the world, and explain how the application of scientific principles related to mechanical energy has led to the enhancement of sports and recreational activities.
- Demonstrate an understanding of forms of energy, energy sources, energy transformations, energy losses, and efficiency, and the operation of common energy-transforming devices.
- construct or investigate devices that involve energy sources, energy transformations, and energy losses, and assess their efficiency.
- analyze and describe the operation of various technologies based on energy transfers and transformations, and evaluate the potential of energy-transformation technologies that use sources of renewable energy.

Competencies	***Contents***	***Suggested Activities***
Students will be able to: • describe and explain the exchange among potential energy, kinetic energy, and internal energy for simple mechanical systems, such as a pendulum, a roller coaster, a spring, a freely falling object • Predict velocities, heights, and spring compressions based on energy conservation • Determine the energy stored in a spring • Differentiate between energy, work, and force • identify the relationship between work and change in kinetic energy	***5. Work energy and power*** **5.1. Work as a scalar product** *(1 period)* **5.2. Work Done by a Constant and Variable Force** *(2 periods)* **5.3. Kinetic Energy, Work Energy theorem**. *(3 periods)* **5.4. Notion of Potential Energy** *(2 periods)* **5.5. Conservation of Energy** *(2 periods)* **5.6. Conservative and Dissipative forces** (2 periods) **5.7 power** *(1 period)*	Before delving into some specific forms of energy, the teacher should address the general topic of energy. Although it is a very important concept in physics, and an important topic in general, energy is notoriously hard to define. You may associate energy with motion, but not all forms of energy involve motion. A very important class of energy, potential energy, is based on the position or configuration of objects, not their motion. Students should understand that they can measure most forces, such as the force of a spring. They can see speed and decide which of two objects is moving faster. They can use a stopwatch to measure time. Quantifying energy is more elusive, because energy depends on multiple factors, such as an object's mass and the square of its speed, or the mass and positions of a system of objects. Despite these caveats, there are important principles that concern all forms of energy. First, there is a relationship between work and energy Second, energy can transfer between objects Third energy can change forms. The first two sections of this unit are meant to pave the way for the consideration of more unifying concept vis. energy. Students may encounter difficulties with the concept of work. Although they repeat statements of the definition they may not grasp the implications of defining work in a precise manner. Discuss the difference between carrying a box down a corridor and pushing the same box along the floor. Examples of this nature can be explained in terms of the definition of work (W =F ●S) as well as in terms of energy changes. Sufficient time should be devoted to discuss energy and its conservation. Only mechanical energy is to be dealt in this unit. Other forms (thermal, electrical, etc.) need not be considered at this point.

Competencies	***Contents***	***Suggested Activities***
• Apply the law of mechanical energy conservation in daily life situations • Analyze situations involving the concepts of mechanical energy and its transformation into other forms of energy according to the law of conservation of energy. • solve problems involving conservation of energy in simple systems with various sources of potential energy, such as springs • analyze and explain common situations involving work and energy, using the work-energy theorem		• A spring-powered toy can demonstrate that work (W =F ●S) is done on a spring, stored in the form of potential energy and converted to kinetic energy. • Hang a pendulum from a support bar. Mount a meter stick horizontally behind the pendulum. Demonstrate that a pendulum starting its swing from a given height on one side of its rest position will swing the same height on the other-side. Measure this with the meter stick. Discuss transformation of energy from kinetic to potential and back. • explain the effects of energy transfers and energy transformations • Estimation of average power developed (by person running upstairs; person repeatedly lifting weights to a height, etc.) • Appropriate calculations. • Mouse trap car race: Mouse trap has stored potential energy when set. Have students build car in which trap is sole motive power. Compete to see which design moves car through greater displacement, which runs longest or highest average speed .Teaches principles of lever, friction, angular motion, and torque and much more. **Experiments** 1. Determination of deformation of a spring due to a weight falling on it and compare the theoretical prediction experimentally **Project Work(s)** 1. investigate and write on the major energy source for house hold use in students' locality

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms work , energy, power ,kinetic energy, potential energy, conservative and dissipative forces; identify work as a scalar product of force and displacement, calculate the work done by constant variable force, derive work-energy theorem, state the law of conservation of energy, apply work-energy theorem and the law of conservation of energy to solve practical problems, Use the principle of conservation of energy in the solution of problems, Distinguish between elastic and inelastic collisions and solve problems involving such collisions, identify the relationship between work and change in kinetic energy, distinguish between conservative and non conservative forces, explain the energy transformation occurring during oscillations, Solve problems involving elastic and inelastic collisions in one and two dimension by using the principles of conservation of momentum and energy.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 6: Rotational motion *(17 periods)*

***Unit outcomes*:** Students will be able to:

- demonstrate an understanding of the concepts of work, energy, momentum, and the laws of conservation of energy and of momentum for objects moving in two dimensions, and explain them in qualitative and quantitative terms
- investigate the laws of conservation of momentum and of energy (including elastic and inelastic collisions) through experiments and analyze and solve problems involving these laws with the aid of vectors, graphs, and free-body diagrams
- analyze and describe the application of the concepts of energy and momentum to the design and development of a wide range of collision and impact-absorbing devices used in everyday life.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • Describe motion of a rigid body about a pivot point • Specify the angular speed, angular velocity of a rotating body • determine the velocity and acceleration of a point in the rotating body • Derive equations of motion with constant angular acceleration • Use equations of motion with constant angular acceleration to solve related problems • Express torque as a cross product of r and F • Apply the cross product definition of torque to solve problems • Solve problems that relates net torque and angular acceleration • Apply the concepts of rotation dynamics and kinetic energy to solve	***6. Rotational motion*** **6.1. Rotation about a fixed axis** *(1 period)* **6.2. Torque and Angular Acceleration** *(2 periods)*	This unit can be developed in analogy with that of linear motion. Emphasis on the analogy between the rotational quantities and linear quantities can be used. **Experiments** 1. Centripetal force and velocity relation may be qualitatively observed by weight suspended from a rotating object through a tube. 2. Spin raw egg rapidly on its side. Stop it and then quickly release it. It begins to rotate again because its yolk never stopped rotating. Hard boiled will not do this. **Demonstrations** 1. disks of identical shape but with different mass distribution from the center can be used to illustrate the moment of inertia concept by rolling them down an inclined plane. 2. Measurement of the moment of inertia of a flywheel falling weight coupled to flywheel). Demonstration using swivel chair or rotating platform (masses held close to and away from the body). 3. a transparency showing multiple exposure of a falling object like a cat falling, a diver etc. is a good starting point to discuss moment of inertia **Project Work(s)** 1. Students may be asked to search literature, internet or from any other source to find out why • why it is easier to balance on a bicycle when moving than when still? • Why a rolling coin not topples until it has nearly stopped rolling? Assist students to apply the equations in physics problems, the first step is to identify the known values and which values are being asked for. Sketching a diagram of the situation may help them with this. The next step is to find an equation that includes both the known and the unknown (asked-for) values. When applying the rotational equations, they should remember that positive displacement and velocity represent counterclockwise motion, and negative displacement and velocity indicate clockwise motion.

Competencies	*Contents*	*Suggested Activities*
problems • State the parallel –axis theorem • Identify factors affecting the moment of inertia of a body • Solve problems involving moment of inertia • Use the relationship between torque and angular momentum, according to Newton's second law, as well as its application in solving problems involving rigid bodies. • Express angular momentum as cross product of r and P • Derive an expression for angular momentum in terms of I and ω • State the law of conservation of angular momentum • Apply the law of conservation of angular momentum in understanding various natural phenomena , and solving problems • Determine the location of center of mass of a uniform rigid body	**6.3. Rotational Kinetic Energy and rotational inertia** *(3 periods)* **6.4. Rotational Dynamics of rigid body** *(3 periods)* **6.5. Parallel axis theorem** *(1 period)* **6.6. Angular Momentum and angular impulse** *(2 periods)* **6.7. conservation of angular momentum** *(2 periods)* **6.8 Center of Mass of a rigid body (circular ring, disc, rod and**	Discuss what causes an object to rotate more or less quickly, and how this relates to rotational work, rotational energy and angular momentum. Let students discover many similarities between linear and rotational dynamics, as well as some crucial differences. Use a wrench that is loosening a nut to explain the concept of torque in more detail. Discuss two of the factors that determine the amount of torque. One factor is how much force *F* is exerted and the other is the distance *r* between the axis of rotation and the location where the

Competencies	***Contents***	***Suggested Activities***
	sphere) *(3 periods)*	force is applied Demonstration: • Rolling a Yo-Yo. let the students construct a yo-yo using discarded metal spool. Best design is one having inner and outer radii which are substantially different, the larger the better. Attach string to inner radius and wrap several turns leaving enough to pass over pulley and attach hanging mass. • Two Cans Race; let students in group select two cans of same size and mass ,one filled with liquid and other mainly solid .alternately use two cans of identical liquids (soft drink in metal),one frozen to behave like solid ,and other not. let them roll down incline together and observe the motion • Bicycle wheel- mass in extended hands. Let the teacher held a bike wheel ,at rest ,overhead with axle vertical while standing or sitting on platform spin wheel with the other hand .without waiting too long (else table friction will reduce angular momentum),grab wheel to stop it thereby restoring entire system to initial zero angular momentum. The students should note the effect of changing axle orientation from vertical to horizontal, while spinning. • A girl rotating on a turntable has arms extended .She suddenly pulls her arms inward and her rotational velocity increases dramatically. Let students discuss and explain in terms of conservation of angular momentum.

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms; axis of rotation, torque, angular acceleration, rotational kinetic energy, rotational inertia, angular momentum, angular impulse; describe center of mass of a rigid body, the relation between torque and angular acceleration; state the law of conservation of angular momentum, the parallel axis theorem; solve problems involving rotational dynamics. Use the equations for uniformly accelerated angular motion; Use the equations relating linear and angular motions; State the similarities and differences between the behavior of rotating bodies and bodies traveling with linear velocity; Identify the factors which determine the moment of inertia of a body; State and apply the law of conservation of angular momentum; determine the velocity and acceleration of a point in the rotating body; demonstrate the direction of angular velocity ,angular acceleration and angular momentum using the right-hand rule.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 7: Equilibrium *(10 periods)*

***Unit outcomes*: Students will be able to:**

- Acquire knowledge and understanding in equilibrium conditions
- Apply physics principles and equations in Solving problems on static equilibrium
- Develop skills in applying the conditions of equilibrium in the solutions of problems.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • Define the term equilibrium • Differentiate static equilibrium from dynamic equilibrium • State the 1st condition of equilibrium • State the equilibrium conditions for a body acted on by coplanar forces • Identify and label the forces and torques acting on the problems related equilibrium • Apply the 1st condition of equilibrium to solve equilibrium problems • Draw free body diagrams to show all the forces acting • State the 2nd condition for equilibrium • Verify the 2nd condition for equilibrium is valid about any arbitrary axis of rotation • Experimentally verify the conditions necessary for	***7. Equilibrium*** **7.1. Equilibrium of a particle** *(2 periods)* **7.2. Moment or Torque of a force** *(3 periods)* **7.3. Conditions of Equilibrium** *(3 periods)* • The first condition for equilibrium • The second condition for equilibrium • Equilibrium of rigid bodies	Torque or Moment of a force can be introduced by careful observation of a turning effect of a force on a spanner or on a door. Students may be guided to conclude that the turning effect of a given force is not only dependent on the magnitude of a force but also on the perpendicular distance of the line of action of the force from the pivot point. Equilibrium of a particle is either the state of rest or uniform motion of a body. This implies the condition of zero net force on the particle. In the case of extended object, two equal and opposite forces may not necessarily cancel each other and may have rotational effect. This point needs emphasis in exercises and demonstrations. **Experiments** 1. The conditions necessary for the equilibrium of a set of non-concurrent forces can be verified by Meter stick, meter stick knife-edge clamps, weight hangers, set of weights, balances and weights. 2. Put a number of coins on the top of a desk and show how stability decreases as the number increases. Help students to relate this with the upward shift of the center of mass of the system **Demonstrations** Stable, unstable and neutral equilibrium of rigid bodies can be demonstrated by putting bottle along the base, top and side respectively **Project Work(s)** Students may report qualitative observation about torque and equilibrium on taps, doors, handlebars on bicycles, and in reference to moving-coil meters and simple motor • Stress the fact that in physics, static equilibrium also requires a threefold path. First, there is no net force acting on the body. Second, there is no net torque on it about any axis of rotation. Finally, in the case of static equilibrium, there is no motion. An object moving with a constant linear and rotational velocity is also in equilibrium, but not in static equilibrium. • Encourage students in tackling equilibrium problems. However; it is not always so easy to determine the axis of rotation. In those cases, it is helpful to remember that if the net torque is zero about one axis, it will be zero about any axis, so the choice of axis is up to

Competencies	***Contents***	***Suggested Activities***
the equilibrium of a set of non- concurrent forces. • Distinguish between coplanar and concurrent forces • Find the resultant of a number of concurrent forces acting at a point • Solve problems involving the equilibrium of coplanar forces • State the conditions for rotational equilibrium • Describe the difference among the terms stable, unstable neutral equilibrium • Explain why objects are stable, unstable and neutral • Explain methods of checking stability, un stability and neutrality of rigid bodies		you. However, this trick only works for cases when the net torque is zero. In general, the torque depends on one's choice of axis.
• Define the term couples • Describe the rotational effects of couples on the rigid body	**7.4. Couples** *(2 periods)*	

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms; equilibrium, moment of a force, and couples; state conditions for equilibrium; solve problems involving equilibrium of rigid bodies. - Distinguish between coplanar and concurrent forces; Find the resultant of a number of concurrent forces acting at a point; Solve problems involving the equilibrium of coplanar forces. State the conditions for there to be no rotation of a body; State the equilibrium conditions for a body acted on by coplanar forces.

Students above minimum requirement level

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.

Unit 8: Properties of bulk matter *(30 periods)*

***Unit outcomes*: ** Students will be able to:

- Gain comprehensive knowledge on basic properties of fluids, thermal properties of matter ,phase changes, ideal- gasses, calorimetry, heat transfer mechanisms
- Realize that the principles of fluid mechanics are widely applicable to modern technology
- demonstrate an understanding of the scientific principles related to fluid static and dynamics, and to hydraulic and pneumatic systems
- work with different temperature scales and solve calorimetry problems
- use specific heats and heats of transformations in the practical application of calorimetry
- analyze and describe the social and economic consequences of the development of technological applications related to the motion of fluids
- Appreciate application of fluid mechanics to the advancement of science and technology.

Competencies	*Contents*	*Suggested Activities*
Students will be able to: • define the terms Hooke's law, elastic limit, stress, strain, Young modulus, Shear modulus ▪ Describe stress -strain relation using stress-strain curve for a material. ▪ Use stress-strain graph to explain terms like, elastic region, elastic limit, plastic region, and breaking strength of a material. • perform calculations involving stress, strain, Young modulus and energy stored in a stretched material • Use the formulas for shear and bulk modulus to solve practical problems ($\Delta P=-B\Delta V/V$	**8. *Properties of bulk matter*** **8.1. Elastic *Behavior*** *(6 periods)* **8.1.1. Stress –strain relation** **8.1.2. Hooke's Law** **8.1.3. Young's modulus** **8.1.4. Bulk Modulus** **8.1.5. Shear Modulus**	The first two sections of this unit introduce the properties of solids and fluids. Connections to the kinetic theory are stressed. Problems that deal with applications of fluids at rest (hydrostatics) and thermal expansion of solids provide interesting examples of the technological applications of physics. Qualitative properties are best understood if students can see demonstrations of these properties. The section on Heat introduces the concepts of thermal physics using microscopic point of view. It expands the concept of conservation of energy, and prepares students for the study of kinetic theory and gas laws. • Determination of the density of an object denser than water using Archimedes's principle • Determine the amount of heat necessary to convert a known quantity of ice at 0^{o} C to water at 0 C • Calibration curve of a thermometer using the laboratory mercury thermometer as a standard • Measurement of specific heat capacity, e.g. of water or a metal by a mechanical or electrical method • Measurement of the specific latent heat of fusion of ice • Measurement of the specific latent heat of vaporization of water • The difference in elasticity between metallic and nonmetallic solids should be shown. Also show the elastic limit, the point at which the bent metal no longer returns to its original shape. • Demonstration: A Cartesian diver shows properties of fluids very nicely. Toys can be used or a diver can be constructed. Take a small test tube, partially filled with water, and cover the open end with part of a balloon, securely fastened with a rubber band. Wait for the tube to float in water, glass end up. Place the tube in a clear plastic squeeze bottle that is completely filled with

Competencies	***Contents***	***Suggested Activities***
and $F/A = S\Delta x/L$) • define and describe the concepts and units related to fluids and to hydraulic and pneumatic systems (e.g., density, atmospheric pressure, absolute pressure, laminar and turbulent flow, pressure, volume, flow rate) • Describe the relationship between pressure due to a liquid and its density, acceleration due to gravity and depth • Derive the expression $P = \rho gh$ • Use $p = \rho gh$ to solve problems related to pressure due to a liquid at rest. • State Pascal's principle • Apply Pascal's principle to solve problems ($P_1 = P_2$ $F_1/A_1 = F_2/A_2$) • state Archimedes' principle and its application • Apply and use Archimedes principle to describe physical phenomena's • State principle of floatation. • Describe the necessary conditions for objects to	**8.2. Fluid Static** *(8 periods)* **8.2.1. Pressure due to a fluid column** **8.2.2. Pascal's law and applications** **8.2.3. Archimedes' principle and applications**	water. Cap the squeeze bottle that is completely filled with water. Cap the squeeze bottle securely, squeeze it, and the test tube should sink. You may have to experiment with the amount of water in the tube needed to produce the dramatic effect. Explain how this demonstrates that fluids transmit pressure equally, and that liquids are much less compressible than gasses. Appreciate the concept of forces in equilibrium to derive the equation for pressure in a liquid. The liquid is assumed to have a uniform density ρ, no matter what its depth. Let a teacher turn on a hose and watch the water flow out, and then cover half the hose end with his /her thumb. The water flows faster through the narrower opening. You have just demonstrated the fluid equation of continuity: How much volume flows per unit time – the volume rate of flow – stays constant in a closed system. The increased speed of the flow at the opening balances the decreased cross sectional area there. Of course after the water leaves the hose with its new speed, it is no longer in the closed system, and you cannot apply the equation of continuity to the resulting spray of droplets. They spread out without slowing down. Discuss how Bernoulli's equation is used to analyze fluid flow at different points in a closed system.. Demonstration: Bernoulli's principle can be demonstrated by supporting a Ping-Pong ball in a stream of air blown from a hair dryer. For an alternate method, use an empty sewing thread spool and insert a pin through an empty sewing thread spool and insert a pin through an index card. Place the pin into one hole of the spool and blow into the other hole. While blowing, turn the spool over. The card will be supported by the reduced pressure between the spool and card. Balloons with 2 –cups: let students demonstrate this experiment Moisten lips of two Styrofoam cups with water and press cups firmly against opposite sides of partially inflated balloon. Upon further the inflation, cups stick to balloon. Students should discuss in groups the cause. Discuss p-T (phase diagram) and three states separated by curves for boiling, freezing, and sublimation, meeting at triple point. Boiling curve terminates at critical point .for water, mention uniqueness of freezing curve resulting in lowering of freezing point with increase of applied pressure. Suspend two light bulbs from table rod .Blow sharply between bulbs so as to hear them clank together. Suspend in field of overhead projector turned on its side to produce magnified image on ceiling.

Competencies	***Contents***	***Suggested Activities***
float or sink • Use the concepts ,Pascal's and Archimedes 'principles to solve numerical problems • Explain how to measure pressure due to gases contained in a container • Demonstrate how a manometer works • Define the terms Adhesion and cohesion • Describe the phenomenon capillarity • Define surface tension and surface energy • Define the angle of contact and account for the shapes of liquid surfaces • Determine the relationship for the capillary rise and use it in problems • Use the definition and formulae to solve problems. • Describe how boiling water and adding detergents affects surface tension ▪ Determine pressure difference across soap. film • Calculate the height through which a liquid rises up a capillary tube	**8.2.4. Surface energy and surface tension** **8.2.5. Pressure difference across a surface film** **8.2.6. Angle of contact and capillary** **8.2.7. Applications of surface tension ideas**	

Competencies	*Contents*	*Suggested Activities*
• Define the term streamline flow as a fluid flow in which the fluid's velocity remains constant at any particular point. • identify the factors affecting the streamlining of cars, boats, planes • Distinguish between streamline and turbulent flow • identify factors affecting laminar flow, and describe examples of laminar flow • Describe the rate of flow of fluid, R. • State Bernoulli's principle • explain the applications of Bernoulli's principle in the fields of technology • Use Bernoulli's equation to solve problems • Derive equation of continuity ($v_1\rho_1A_1 = v_2\rho_2A_2$ $v_1A_1 = v_2A_2 = R$) • Apply equation of continuity to solve problems • Derive Bernoulli's equation $P_1 + ½\rho v_1^2 = P_2 + ½\rho v_2^2$ and $P + ½\rho v^2 = k$ for horizontal flow • Describe the working	**8.3. Fluid Dynamics** *(8 periods)* **8.3.1. Streamline and turbulent flow** **8.3.2. Equation of Continuity** **8.3.3. Bernoulli's Equation**	

Competencies	*Contents*	*Suggested Activities*
mechanism of a venture meter • Define the term viscosity • Define coefficient of viscosity of a fluid • Define drag force • Explain the effect of drag force on the fluids motion • Define the term laminar flow as the flow of layers in a viscous fluid • State Stoke's law and use it in problems • State Poiseulle's law • Use Poiseulle's law $R=\Pi r^4 \Delta P/8\ \eta L$ to solve related problems	**8.3.4. Viscosity**	
• State the factors affecting the rate of fluid flow through a pipe • State the condition at which a body moving in a fluid attains its terminal velocity • Describe what Reynolds number is	**8.3.5. Stokes' law**	
• Define the terms: calorimetery, phase, phase change, phase diagram, state variable, critical point, triple point, latent heat, heat capacity, specific heat capacity	**8.3.6. Terminal Velocity**	
• Distinguish between specific heat capacity and heat capacity	**8.3.7. Reynolds's number**	

Competencies	*Contents*	*Suggested Activities*
• Distinguish between the concepts: heat, temperature, internal energy, work • Identify the units for heat, heat capacity, specific heat capacity, latent heat • Define phase change as Transformation between solid and liquid, liquid and gas, or solid and gas • Identify phase change consumes energy or releases energy while temperature stays constant • Define Latent heat as: Energy required per kilogram to cause a phase change in a given material • Describe experiments by which latent heat can be measured • Distinguish between critical point and triple point • Use $Q = L_f m$ and $Q = L_v m$ to solve related problems • Explain how to specify the heat of fusion or vaporization of a material using calorimeter • Explain the factors which determine the rate of	**8.4. Heat, Temperature and Thermal Expansion** *(8 periods)* **8.4.1. Specific heat capacity** **8.4.2. Change of state**	

Competencies	***Contents***	***Suggested Activities***
flow of heat through a material • Describe the thermal expansion of solids in terms of molecular theory of matter • State the factors affecting the rate of heat flow in conduction • Use the equation H=KAΔT/ L to solve related problems • State the factors affecting the rate of heat flow in convection • Apply the concept to explain the weather variation like sea breeze and land breeze • State Stefan-Boltzman's law • Define radiation as mechanism of heat transfer by means of electromagnetic waves • State the factors affecting the rate of heat flow in radiation • Use the relation $P_{rad} = \sigma\varepsilon AT^4$ $P_{abs} = \sigma\varepsilon AT_{env}^4$ to solve related problems • Perform calculations involving expansivity • Solve problems involving thermal conductivity	**8.4.3. Calorimetry** **8.4.4. Heat transfer** **8.4.5. Stefan –Boltzmann law** **8.4.6. Thermal Conductivity** • Conduction • convection • Radiation	

Competencies	***Contents***	***Suggested Activities***
• Describe the green house effect	• Global warming and green house effect	

Assessment

The teacher should assess each students work continuously over the whole unit and compare it with the following description, based on the competencies, to determine whether the student has achieved the minimum required level.

Students at minimum requirement level

A student working at the minimum requirement level will be able to: define the terms; stress, strain, modulus, pressure, surface energy, surface tension, capillarity, streamlined, turbulent flow, viscosity, terminal velocity; state Hook's law, PASCAL's law, Archimedes' principle, Stoke's law, Stefen-Boltzmann's law and Newton's law of cooling; describe the stress-strain relation, equation of continuity, Bernoulli's equation, Reynolds' number, change of state and heat transfer; identify Young's modulus, Bulk modulus, Shear modulus; solve problems involving elastic behavior, fluid statics and heat ,use equation of continuity and Bernoulli's principle to solve problems; Describe the application of Bernoulli's principle in everyday life situation; State and use Bernoulli's equation to solve problems; Define the angle of contact and account for the shapes of liquid surfaces; Determine the relationship for the capillary rise and use it in problems; Define the terms: calorimetery, change of phase, latent heat, heat capacity, specific heat capacity; Distinguish between the concepts: heat, temperature, internal energy, work; Identify the units for heat, heat capacity, specific heat capacity, latent heat; Solve problems involving thermal conductivity, change of state and expansivity; Describe properties that can be used for temperature measurement; Explain the methods used for the measurement of specific heat capacities; Relate latent heat to intermolecular forces.

Students above minimum requirement level

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Students below minimum requirement level

Students working below the minimum requirement level will require extra help if they are to catch up with rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.