MODULE - 3

for

PHYSICS LECTURERS

2016-17

STUDY OF INTERACTION AMONG PARTICLES AND WAVES

State Council of Educational Research and Training

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Contents

ABOUT THE MODULES.......

The series of Six Modules of physics at the Higher Secondary Stage has been developed with a view that the school education is crucial and challenging as it is a transition from general science to discipline-based curriculum. The recommendations of National Curriculum Framework-2005 have been followed, keeping the disciplinary approach with rigour and depth, appropriate to the comprehension level of learners.

It is expected that, these six modules will help teachers teaching XI and XIIth classes will develop an interest in the learners to study Physics as a discipline and inculcate in learners the abilities, useful concepts of Physics in real-life situations for making learning of Physics relevant, meaningful and interesting. The learner is expected to realize and appreciate the interface of Physics with other disciplines.

RATIONALE

Physics is being offered as an elective subject at the higher secondary stage of school education. At this stage, the students take up Physics, as a discipline, To achieve the primary aim of the Curriculum - to create interest in the learmer, to pursue their future careers in basic sciences- physics. This demands sufficient conceptual background of Physics which would eventually make them competent to meet the challenges of academic and professional courses after the higher secondary stage.

The six modules is an effort in reforming and updating the Physics curriculum based on the feedback received from the teachers during earlier INSET programmes organised by SCERT time to time. The educational and curricular concerns and issues provided in the National Curriculum Framework-2005, is addressed to a greater extent.

SALIENT FEATURES

• Emphasis on basic conceptual understanding of content.

• Promoting process-skills, problem-solving abilities and applications of Physics concepts/content, useful in real-life situations for making Physics learning more relevant, meaningful and interesting.

• Emphasis on Numerical analysis.

• Emphasis on Technical Educational Movie – Analysis from Physics and scientific approach

• Emphasis on Physics-related technological/industrial aspects to cope up with changing demand of society committed to the use of Physics, technology and informatics.

• Providing logical sequencing of the concepts and their linkages for better learning and matching the concepts/content with comprehension level of the learners.

• Reducing the curriculum load by eliminating overlapping of concepts/content within the discipline of Physics or with other disciplines; reducing the descriptive portion and providing suitable formulation/depth of treatment appropriate to the comprehension level of learners, making room for contemporary core - topics and emerging curricular areas in Physics.

• The content are so sequenced as to provide different dimensions of Physics as a discipline. Each Module has been arranged with a topic, content related practical work (one core experiment, two activities to be evaluated)

• There is an imperative need for evaluating the learners through Continuous and Comprehensive Evaluation of various concepts covered in a Unit.

With this background, the Physics curriculum at the higher secondary stageattempts to:

• Strengthen the concepts developed at the secondary stage to provide firm ground work and foundation for further learning Physics at the tertiary level more effectively and learning the relationship with daily-life situations;

• Develop conceptual competence in the learners and make them realize and appreciate the interface of Physics with other disciplines;

• Expose the learners to different processes used in Physics-related industrial and technological applications;

• Develop process-skills and experimental, observational, manipulative, decision- making and investigatory skills in the learners;

• Promote problem-solving abilities and creative thinking to develop interest in the learners in the study of Physics as a discipline;

• Understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of Physics towards the improvement of quality of life and human welfare;

• Physics teaching-learning at the higher secondary stage enables the learners to comprehend the contemporary knowledge and develop aesthetic sensibilities and process skills. The experimental skills and process-skills developed together with conceptual Physics knowledge prepare the learners for more meaningful learning experiences and contribute to the significant improvement of quality of life. The learners would also appreciate the role and impact of Physics and technology, and their linkages with overall national development.

PGT-PHYSICS	
S.No.	**TITLE**
Module-1	**Micro Level Understanding of Physics in Macroscopic View** • Free Body Diagram and Resolution of Vector • Electrostatic Properties of Dielectrics/Conductors • Potentiometer • Open Ended Questions • Marking Scheme and Question Paper
Module-2	**Physics of Spherical and Circular Surfaces** • Rolling Friction • Concept of COG and COM • Experiment to find Focal Length of Mirror • Experiment to find Focal Length of a Convex Lens • Open Ended Questions • Marking Scheme and Question Paper.
Module-3	**Study of Interaction among Particles and Waves** • Superposition of Waves • Magnetism in Action • Fun with Pendulum • Open Ended Questions • Marking Scheme and Question Paper
Module-4	**Energy Transport with and without Molecules** • Heat Transfer • Thermodynamics • Communication Systems • Resonance of Air Columns • Use of Media in Enhancing Physics Teaching-Learning Strategies • Learning Outcome - How Teachers can Educate their Students on the Science of 'Interstellar' • Marking Scheme and Question Paper
Module-5	**Study and Application of Matter and Electricity** • Fluids in Motion and Energy Conservation • Electrical Capacitance • Sonometer (Experiment) • Use of Media in Enhancing Physics Teaching • Marking Scheme and Question Paper
Module-6	**Particle Motion to Wave Motion** • Projectile Motion • Qualitative Analysis of Wave Optics • Capillary Rise Method • Use of Media in Enhancing Physics Teaching-Learning Strategies • Marking Scheme and Question Paper

Abstract of the six Modules

Module: 1 – Micro Level Understanding of Physics in Macroscopic View

Mathematics as a field influences Physics to a greater extent. On the contrary, one can also say that Physics adds meaning to Mathematics. This module requires a greater mathematical strength to understand and impart in a classroom situation. It covers the free body diagram where many forces are involved, resolution of vectors-force, indication of electric field in dielectric and conductors. These topics demand utmost dedication and will to learn and apply in the situations that evolve in due course. Activity on potentiometer is taken for in depth study with hands-on-tools to overrule the practical problems faced in the laboratory. This segment will enhance your skills in the experimentation and thereby the theory also will get strengthened. Applications and computational skills for problem solving have been stressed in the question papers now-a-days. Rather than solving a single question with values if one can generalize the problem the student can in fact do a lot of numerical questions and will enhance his confidence in Physics. This will also encourage the student to take up Physics as a subject in higher classes. You also stand out to gain a greater insight into physics by learning to analyse and interpret the data.

Happy using the module and Learning the content the way it is said.

Module 2 – Physics of Spherical and Circular Surfaces

This module attempts to help teachers to integrate scientific practices into the learning of Physics. A sound knowledge and understanding of the core observations, concepts and quantitative theoretical structures that constitute our contemporary understanding of the concept is aimed at here. This module emphasize on problem solving skills with nuances and generalization. Care has been taken to cover all areas in the numerical practice across the modules. Here an introduction to magnetic effect of current, Ampers' circuital law, its application are discussed in detail besides the most important aspect of transportation - rolling motion. The simple way by which Rolling can be introduced within the limitations of CBSE Board Syllabus is followed. The activities of optics and optical benches are taken from the practical side as many students fail to make an image without Parallax. The methods that will be shown hands-on will facilitate the teacher and in-turn he student in their care.

Happy using the module and Learning the content the way it is said.

Module 3 – Study of Interaction among Particles and Waves

Magnetism and Waves are two topics that fail to induce any interest in the student because of the way it is introduced. So a lucid style and a comparative approach on the interaction of waves is done efficiently. Numerical questions are open ended and are to be solved with care such that a similar twisted questions are done with ease. The numerical session in groups will enhance the teaching ability as the teachers in the group may provide multiple approach to the same query or situation. In a way one may also understand the defect in our organs like the eye and ear. A normal ear retains the sound for about 1/10 of a second. A human eye can observe an event if 24 frames are shown per second.

A simple experiment which may provide a lot of scope for the guided projects is a Simple pendulum. This is dealt with in detail so that the many students can be given one aspect of the experiment for the investigatory project.

Happy using the module and Learning the content the way it is said.

Module 4 – Energy Transport with and without Molecules

A great philosopher has said "Change is a constant in life". Keeping these words in mind, we as teachers keep learning and implementing in the classes the best of the teaching practices and the simplified ways and means to understand any topic. The topics of Heat and Thermodynamics, Communication systems and some experiments on Resonance are on the neglected list over a period of time. The student tries to do the minimum work on these areas and the absence of intent hinders the learning process. The fundamental aspects of the topics transfer of Heat and Thermodynamics is dealt with in a manner that will ease the difficulty in learning. The degrees of freedom in different molecular formation can be done with ease with idea incorporated here. The experiment on the Resonance tube apparatus is taken for a complete demonstration and this will ease the difficulty in performing them in the school. The content of the chapter – Communication Systems is available in plenty. But how to make the student to understand the same is a difficult task which was expressed by the teachers in the previous INSET programme. The content may look the same way as the rest but as you attend the session you may feel the way the content be used for the student to score full marks allotted for the chapter. Following a regular pattern may make a boredom. To avoid there should be certain traits we need to imbibe as teachers from time to time. For the first time incorporating Movie Session for learning new traits to be used in class, learn the scientific ways of improving Observation and Interpretation skills and the way technological tools can be used in the teacher training programme is done. The movie that is to be shown here partly is to bring certain changes in your classroom so that the good traits from the reel world is a reality and helps the student community. The attempt by SCERT in providing Freedom for the content developers in bringing necessary variations in the regular topics that has been provided will make this module a unique one. Happy using the module and Learning the content the way it is said.

Module 5 – Study and Application of Matter and Electricity

Time and again there has been a difficulty felt in the classroom in dealing with some interesting but felt hard topics in the class XI and XII Physics syllabus. Some of these areas include Bernoulli’s theorem and Capacitance. They play a great role in the scoring pattern of the student and to a greater extent induce interest in our subject. An attempt is made here to simplify and apply to a greater extent in the classroom. Why a ball spinned around rises up in the sky when the student is playing cricket is an unanswered question in his mind. The module here with you is an answer to bring the spinning ball into the classroom. Various other examples like the quantifying the volume of water that is being received from a canal outside Delhi will bring reality to classrooms. The capacitors as a energy storage device and their combinations in various circuits have revolutionised the field of communication. Unless and until the student is informed of the daily use of capacitors.

while doing the topic of Electrostatics - Capacitance it is difficult to make them mentally prepared for conceptualisation. The numerical questions given as practice questions are to prepare the student through the teachers for the board examination. In the practical part there is apprehension in the handling of Sonometer. This induced us to build a session on Sonometer. The session will be hands-on on the stage with the recording of results highlighting the intricacies of the practical handling of Sonometer. One may understand that simple recording is not doing experiment but to understand the nuances of the topic is of prime focus. Following a regular pattern in the teaching –learning process may make a boredom. To avoid there should be certain traits we need to imbibe as teachers from time to time. For the first time incorporating Movie Session for learning new traits to be used in class, learn the scientific ways of improving Observation and Interpretation skills and the way technological tools can be used in the teacher training programme is done. The movie that is to be shown here partly is to bring certain changes in your classroom so that the good traits from the reel world is a reality and helps the student community. The attempt by SCERT in providing Freedom for the content developers in bringing necessary variations in the regular topics that has been provided will make this module a unique one.

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Module 6 – Particle Motion to Wave Motion

To take interest, identify, acknowledge ,unfolding curiosities ,seeking for explanations and reasons is the real fun of Science. Bringing down the observations to find theoretical justification and explanations to the observations makes the difficult part of the subject. Perception is the key reference of interpreting the world around . Inculcating the ability of qualitative understanding and idea is another bless that the students deserve to be served. Throwing a ball while playing a simple game makes it move along a curved path that most people know, the purpose is to create fascination and curiosity of the level that the child feels to interrogate every specification that the child observes and seeks for a theory that supports the same. The projectile motion faces lack of connect of how the various parameters like horizontal range , maximum height serves to make student’s life easy.The topic aims to extend and connect the theoretical findings with its applications in the real world to enable students to appreciate the value of the various derivations ,their findings and understanding from the same. To make someone realize the existence of something for which first hand experience is difficult to attain is a task,which if accomplished is a real achievement.Wave optics being one of the most mind opening experience to realize the possibilities of what you observe in nature, the qualitative description of the same has been taken up in the module.The purpose stays as basic as to widen the vision and possibilities that a student can incorporate to extract understanding and knowledge from nature.For the things there in books and theories are hard to experience and trust in real life , experiencing that perception being existing for real people gives a better idea of authentic existence of the same . Movies based on Scientific ideology to avail critical thinking to the learners , so as to go down the the line to the thought process of the person who had thought about this edge of the Scientific development and progress is another concern of the module.

Happy using the module and Learning the content the way it is said.

PHYSICS (Code No. 042)

Senior Secondary stage of school education is a stage of transition from general education to discipline-based focus on curriculum. The present updated syllabus keeps in view the rigour and depth of disciplinary approach as well as the comprehension level of learners. Due care has also been taken that the syllabus is comparable to the international standards. Salient features of the syllabus include:

- Emphasis on basic conceptual understanding of the content.
- Emphasis on use of SI units, symbols, nomenclature of physical quantities and formulations as per international standards.
- Providing logical sequencing of units of the subject matter and proper placement of concepts with their linkage for better learning.
- Reducing the curriculum load by eliminating overlapping of concepts/content within the discipline and other disciplines.
- Promotion of process-skills, problem-solving abilities and applications of Physics concepts.

Besides, the syllabus also attempts to

- strengthen the concepts developed at the secondary stage to provide firm foundation for further learning in the subject.
- expose the learners to different processes used in Physics-related industrial and technological applications.
- develop process-skills and experimental, observational, manipulative, decision making and investigatory skills in the learners.
- promote problem solving abilities and creative thinking in learners.
- develop conceptual competence in the learners and make them realize and appreciate the interface of Physics with other disciplines.

PHYSICS (Code No. 042)
COURSE STRUCTURE
Class XI (Theory) (2016-17)

Time: 3 hrs. **Max Marks: 70**

		No. of Periods	Marks
Unit-I	**Physical World and Measurement**	10	23
	Chapter-1: Physical World		
	Chapter-2: Units and Measurements		
Unit-II	**Kinematics**	24	
	Chapter-3: Motion in a Straight Line		
	Chapter-4: Motion in a Plane		
Unit-III	**Laws of Motion**	14	
	Chapter-5: Laws of Motion		

Unit-IV	**Work, Energy and Power**	12	17
	Chapter-6: Work, Energy and Power		
Unit-V	**Motion of System of Particles and Rigid Body**	18	
	Chapter-7: System of Particles and Rotational Motion		
Unit-VI	**Gravitation**	12	
	Chapter-8: Gravitation		
Unit-VII	**Properties of Bulk Matter**	24	20
	Chapter-9: Mechanical Properties of Solids		
	Chapter-10: Mechanical Properties of Fluids		
	Chapter-11: Thermal Properties of Matter		
Unit-VIII	**Thermodynamics**	12	
	Chapter-12: Thermodynamics		
Unit-IX	**Behaviour of Perfect Gases and Kinetic Theory of Gases**	08	
	Chapter-13: Kinetic Theory		
Unit-X	**Oscillations and Waves**	26	10
	Chapter-14: Oscillations		
	Chapter-15: Waves		
Total		**160**	**70**

Unit I: Physical World and Measurement **10 Periods**

Chapter-1: Physical World

Physics-scope and excitement; nature of physical laws; Physics, technology and society.

Chapter-2: Units and Measurements

Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures.

Dimensions of physical quantities; dimensional analysis and its applications.

Unit II: Kinematics **24 Periods**

Chapter-3: Motion in a Straight Line

Frame of reference, Motion in a straight line: Position-time graph, speed and velocity.

Elementary concepts of differentiation and integration for describing motion, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs.

Relations for uniformly accelerated motion (graphical treatment).

Chapter-4: Motion in a Plane

Scalar and vector quantities; position and displacement vectors; general vectors and their notations; equality of vectors; multiplication of vectors by a real number; addition and subtraction of vectors; relative velocity; Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors.

Motion in a plane, case of uniform velocity and uniform acceleration-projectile motion, uniform circular motion.

Unit IV: Laws of Motion

Chapter-5: Laws of Motion

Intuitive concept of force; Inertia; Newton's first law of motion; Momentum and Newton's second law of motion; impulse; Newton's third law of motion.

Law of conservation of linear momentum and its applications.

Equilibrium of concurrent forces; Static and kinetic friction; Laws of friction; rolling friction; lubrication.

Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

Unit IV: Work, Energy and Power

Chapter-6: Work, Energy and Power

Work done by a constant force and a variable force; kinetic energy; work-energy theorem; power.

Notion of potential energy; potential energy of a spring; conservative forces: conservation of mechanical energy (kinetic and potential energies); non-conservative forces: motion in a vertical circle; elastic and inelastic collisions in one and two dimensions.

Unit V: Motion of System of Particles and Rigid Body

Chapter-7: System of Particles and Rotational Motion

Centre of mass of a two-particle system; momentum conservation and centre of mass motion.

Centre of mass of a rigid body; centre of mass of a uniform rod.

Moment of a force: torque; angular momentum; law of conservation of angular momentum and its applications.

Equilibrium of rigid bodies; rigid body rotation and equations of rotational motion; comparison of linear and rotational motions.

Moment of inertia; radius of gyration; values of moments of inertia for simple geometrical objects (no derivation). Statement of parallel and prependicular axes theorems and their applications.

Unit VI: Gravitation

Chapter-8: Gravitation

Kepler's laws of planetary motion, universal law of gravitation.

Acceleration due to gravity and its variation with altitude and depth.

Unit VII: Properties of Bulk Matter — 24 Periods

Chapter-9: Mechanical Properties of Solids

Elastic behaviour; Stress-strain relationship; Hooke's law; Young's modulus; bulk modulus; shear modulus of rigidity; Poisson's ratio; elastic energy.

Chapter-10: Mechanical Properties of Fluids

Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes); effect of gravity on fluid pressure.

Viscosity; Stokes' law; terminal velocity; streamline and turbulent flow; critical velocity; Bernoulli's theorem and its applications.

Surface energy and surface tension; angle of contact; excess of pressure across a curved surface; application of surface tension ideas to drops, bubbles and capillary rise.

Chapter-11: Thermal Properties of Matter

Heat; temperature; thermal expansion; thermal expansion of solids, liquids and gases; anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity.

Heat transfer-conduction, convection and radiation; thermal conductivity; qualitative ideas of Blackbody radiation; Wein's displacement Law; Stefan's law; Green house effect.

Unit VIII: Thermodynamics — 12 Periods

Chapter-12: Thermodynamics

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics); heat, work and internal energy. First law of thermodynamics; isothermal and adiabatic processes.

Second law of thermodynamics: reversible and irreversible processes; Heat engine and refrigerator.

Unit IX: Behaviour of Perfect Gases and Kinetic Theory of Gases — 08 Periods

Chapter-13: Kinetic Theory

Equation of state of a perfect gas; work done in compressing a gas.

Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

Unit X: Oscillations and Waves — 26 Periods

Chapter-14: Oscillations

Periodic motion - time period, frequency, displacement as a function of time, periodic functions.

Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a loaded spring-restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum derivation of expression for its time period.

Free, forced and damped oscillations (qualitative ideas only), resonance.

Chapter-15: Waves

Wave motion: Transverse and longitudinal waves, speed of wave motion, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect.

PRACTICALS **Total Periods: 60**

The record, to be submitted by the students, at the time of their annual examination, has to include:

- Record of at least 15 Experiments [with a minimum of 6 from each section], to be performed by the students.
- Record of at least 5 Activities [with a minimum of 2 each from section A and section B], to be demonstrated by the teachers.
- Report of the project to be carried out by the students.

EVALUATION SCHEME

Time Allowed: Three hours **Max. Marks: 30**

Two experiments one from each section	8+8 Marks
Practical record (experiment and activities)	6 Marks
Investigatory Project	3 Marks
Viva on experiments, activities and project	5 Marks
Total	**30 Marks**

SECTION-A

Experiments

1. To measure diameter of a small spherical/cylindrical body and to measure internal diameter and depth of a given beaker/calorimeter using Vernier Callipers and hence find its volume.
2. To measure diameter of a given wire and thickness of a given sheet using screw gauge.
3. To determine volume of an irregular lamina using screw gauge.
4. To determine radius of curvature of a given spherical surface by a spherometer.
5. To determine the mass of two different objects using a beam balance.
6. To find the weight of a given body using parallelogram law of vectors.
7. Using a simple pendulum, plot its $L-T^2$ graph and use it to find the effective length of second's pendulum.
8. To study variation of time period of a simple pendulum of a given length by taking bobs of same size but different masses and interpret the result.
9. To study the relationship between force of limiting friction and normal reaction and to find the co-efficient of friction between a block and a horizontal surface.
10. To find the downward force, along an inclined plane, acting on a roller due to gravitational pull of the earth and study its relationship with the angle of inclination θ by plotting graph between force and $\sin\theta$.

Activities

(for the purpose of demonstration only)

1. To make a paper scale of given least count, e.g., 0.2cm, 0.5 cm.
2. To determine mass of a given body using a metre scale by principle of moments.
3. To plot a graph for a given set of data, with proper choice of scales and error bars.
4. To measure the force of limiting friction for rolling of a roller on a horizontal plane.
5. To study the variation in range of a projectile with angle of projection.
6. To study the conservation of energy of a ball rolling down on an inclined plane (using a double inclined plane).
7. To study dissipation of energy of a simple pendulum by plotting a graph between square of amplitude and time.

SECTION-B

Experiments

1. To determine Young's modulus of elasticity of the material of a given wire.
2. To find the force constant of a helical spring by plotting a graph between load and extension.
3. To study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between P and V, and between P and 1/V.
4. To determine the surface tension of water by capillary rise method.
5. To determine the coefficient of viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body.
6. To study the relationship between the temperature of a hot body and time by plotting a cooling curve.
7. To determine specific heat capacity of a given solid by method of mixtures.
8. To study the relation between frequency and length of a given wire under constant tension using sonometer.
9. To study the relation between the length of a given wire and tension for constant frequency using sonometer.
10. To find the speed of sound in air at room temperature using a resonance tube by two resonance positions.

Activities

(for the purpose of demonstration only)

1. To observe change of state and plot a cooling curve for molten wax.
2. To observe and explain the effect of heating on a bi-metallic strip.
3. To note the change in level of liquid in a container on heating and interpret the observations.
4. To study the effect of detergent on surface tension of water by observing capillary rise.
5. To study the factors affecting the rate of loss of heat of a liquid.
6. To study the effect of load on depression of a suitably clamped metre scale loaded at (i) its end (ii) in the middle.
7. To observe the decrease in presure with increase in velocity of a fluid.

Practical Examination for Visually Impaired Students

Class XI

Note: Same Evaluation scheme and general gudelines for visually impaired students as given for Class XII may be followed.

A. Items for Identification/ Familiarity of the apparatus for assessment in practicals (All experiments)

Spherical ball, Cylindrical objects, vernier calipers, beaker, calorimeter, Screw gauge, wire, Beam balance, spring balance, weight box, gram and miligram weights, forceps, Parallelogram law of vectors apparatus, pulleys and pans used in the same 'weights' used , Bob and string used in a simple pendulum, meter scale, split cork, suspension arrangement, stop clock/stop watch, Helical spring, suspension arrangement used, weights, arrangement used for measuring extension, Sonometer, Wedges, pan and pulley used in it, 'weights' Tuning Fork, Meter scale, Beam balance, Weight box, gram amd miligram weights, forceps, Resonance Tube, Tuning Fork, Meter scale, Flask/Beaker used for addinng water.

B. List of Practicals

1. To measure diameter of a small spherical/cylindrical body using vernier calipers.

2. To measure the internal diameter and depth of a given beaker/calorimeter using vernier calipers and hence find its volume.

3. To measure diameter of given wire using screw gauge.

4. To measure thickness of a given sheet using screw gauge.

5. To determine the mass of given object using a beam balance.

6. To find the weight of given body using the parallelogram law of vectors.

7. Using a simple pendulum plot L-T and L-T2 graphs. Hence find thye effective lenghth of second's pendulum using appropriate lenght values.

8. To find the force constant of given helical spring by plotting a graph between load and extension.

9. (i) To study the relation between frequency and length of a given wire under constant tension using a sonometer.

(ii) To study the relation between the length of a given wire and tension, for constant frequency, using a sonometer.

10. To find the speed of sound in air, at rrom temperature, using a resonance tube, by observing the two resonance position.

Note: The above practicals may be carried out in an experimential mannner rather than recording observations.

Prescribed Books:

1. Physics Part-1, Textbook for Class XI, Published by NCERT

2. Physics Part-II, Textbook for Class XI, Published by NCERT

3. The list of other related books and manuals brought out by NCERT (consider multimedia also.)

PHYSICS (Code No. 042)
QUESTION PAPER DESIGN
CLASS - XI (2016-17)

Time 3 Hours **Max. Marks: 70**

S. No.	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer-I (SA-I) (2 marks)	Short Answer -II (SA-II) (3 marks)	Value based question (4 marks)	Long Answer (LA) (5 marks)	Total Marks	% Weightage
1.	**Remembering- (Knowledge based** Simple recall questions, to know specific facts, terms, concepts, principles, or theories, identify, define, or recite information)	2	1	1	-	-	7	10%
2	**Understanding- (Comprehension** -to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	-	2	4	-	1	21	30%
3	**Application -** (Use abstract - information in concrete situation, to apply knowledge to new situations, Use given content to interpret a situation, provide an example, or solve a problem)	-	2	4	-	1	21	30%
4	**Higher Order Thinking Skills - (Analysis & Synthesis-** Classify, compare, contrast, or differentiate between different pieces of information, Organize and/or integrate unique pieces of information from a variety of sources)	2	-	1	-	1	10	14%
5	**Evaluation -** (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	1	-	2	1	-	11	16%
	TOTAL	**5x1=5**	**5x2=10**	**12x3=36**	**1x4=4**	**3x5=15**	**70(26)**	**100%**

Question Wise Break Up

Type of Question	Mark per Question	Total No. of Questions	Total Marks
VSA	1	5	05
SA-I	2	5	10
SA-II	3	12	36
VBQ	4	1	04
LA	5	3	15
Total		**26**	**70**

1. Internal Choice: *There is no overall choice in the paper. However, there is an internal choice in one question of 2 marks weightage, one question of 3 marks weightage and all the three questions of 5 marks weightage.*

2. *The above template is only a sample. Suitable internal variations may be made for generating similar templates keeping the overall weightage to different form of questions and typology of questions same.*

CLASS XII (2016-17)
(THEORY)

Time: 3 hrs. **Max Marks: 70**

		No. of Periods	Marks
Unit-I	**Electrostatics**	22	15
	Chapter-1: Electric Charges and Fields		
	Chapter-2: Electrostatic Potential and Capacitance		
Unit-II	**Current Electricity**	20	
	Chapter-3: Current Electricity		
Unit-III	**Magnetic Effects of Current and Magnetism**	22	16
	Chapter-4: Moving Charges and Magnetism		
	Chapter-5: Magnetism and Matter		
Unit-IV	**Electromagnetic Induction and Alternating Currents**	20	
	Chapter-6: Electromagnetic Induction		
	Chapter-7: Alternating Current		
Unit-V	**Electromagnetic Waves**	04	17
	Chapter-8: Electromagnetic Waves		
Unit-VI	**Optics**	25	
	Chapter-9: Ray Optics and Optical Instruments		
	Chapter-10: Wave Optics		
Unit-VII	**Dual Nature of Radiation and Matter**	08	10
	Chapter-11: Dual Nature of Radiation and Matter		
Unit-VIII	**Atoms and Nuclei**	14	
	Chapter-12: Atoms		
	Chapter-13: Nuclei		
Unit-IX	**Electronic Devices**	15	12
	Chapter-14: Semiconductor Electronics: Materials, Devices and Simple Circuits		
Unit-X	**Communication Systems**	10	
	Chapter-15: Communication Systems		
Total		**160**	**70**

Unit I: Electrostatics — 22 Periods

Chapter-1: Electric Charges and Fields

Electric Charges; Conservation of charge; Coulomb's law-force between two point charges; forces between multiple charges; superposition principle and continuous charge distribution.

Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric fleld.

Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).

Chapter-2: Electrostatic Potential and Capacitance

Electric potential; potential difference; electric potential due to a point charge, a dipole and system of charges; equipotential surfaces; electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field.

Conductors and insulators; free charges and bound charges inside a conductor. Dielectrics and electric polarisation; capacitors and capacitance; combination of capacitors in series and in parallel; capacitance of a parallel plate capacitor with and without dielectric medium between the plates; energy stored in a capacitor.

Unit II: Current Electricity — 20 Periods

Chapter-3: Current Electricity

Electric current; flow of electric charges in a metallic conductor; drift velocity; mobility and their relation with electric current; Ohm's law; electrical resistance; V-I characteristics (linear and non-linear), electrical energy and power; electrical resistivity and conductivity; Carbon resistors; colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance.

Internal resistance of a cell; potential difference and emf of a cell; combination of cells in series and in parallel; Kirchhoff's laws and simple applications; Wheatstone bridge, metre bridge.

Potentiometer - principle and its applications to measure potential difference and for comparing EMF of two cells; measurement of internal resistance of a cell.

Unit III: Magnetic Effects of Current and Magnetism — 22 Periods

Chapter-4: Moving Charges and Magetism

Concept of magnetic field, Oersted's experiment.

Biot - Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids (only qualitative treatment); force on a moving charge in uniform magnetic and electric fields; Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field; force between two parallel current-carrying conductors-definition of ampere, torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

Chapter-5: Magnetism and Matter

Current loop as a magnetic dipole and its magnetic dipole moment; magnetic dipole moment of a revolving electron; magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis; torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid; magnetic field lines; earth's magnetic field and magnetic elements.

Para-, dia- and ferro - magnetic substances, with examples. Electromagnets and factors affecting their strengths; permanent magnets.

Unit IV: Electromagnetic Induction and Alternating Currents — 20 Periods

Chapter-6: Electromagnetic Induction

Electromagnetic induction; Faraday's laws, induced EMF and current; Lenz's Law, Eddy currents.

Self and mutual induction.

Chapter-7: Alternating Current

Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance; LC oscillations (qualitative treatment only); LCR series circuit; resonance; power in AC circuits, power factor; wattless current.

AC generator and transformer.

Unit V: Electromagnetic waves — 04 Periods

Chapter-8: Electromagnetic Waves

Basic idea of displacement current, Electromagnetic waves, their characteristics, their Transverse nature (qualitative ideas only).

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit VI: Optics — 25 Periods

Chapter-9: Ray Optics and Optical Instruments

Ray Optics: Reflection of light; spherical mirrors; mirror formula; refraction of light; total internal reflection and its applications; optical; fibres; refraction at spherical surfaces; lenses; thin lens formula; lensmaker's formula; magnification, power of a lens; combination of thin lenses in contact; refraction and dispersion of light through a prism.

Scattering of light - blue colour of sky and reddish apprearance of the sun at sunrise and sunset.

Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Chapter-10: Wave Optics

Wave optics: Wave front and Huygen's principle; reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle. Interference; Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light; diffraction due to a single slit; width of central maximum; resolving power of microscope and astronomical telescope, polarisation; plane polarised light; Brewster's law; uses of plane polarised light and Polaroids.

Unit VII: Dual Nature of Radiation and Matter **08 Periods**

Chapter-11: Dual Nature of Radiation and Matter

Dual nature of radiation; Photoelectric effect; Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light.

Matter waves-wave nature of particles ; de-Broglie relation; Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained).

Unit VIII: Atoms and Nuclei **14 Periods**

Chapter-12: Atoms

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum.

Chapter-13: Nuclei

Composition and size of nucleus; Radioactivity; alpha, beta and gamma particles/rays and their properties; radioactive decay law.

Mass-energy relation; mass defect; binding energy per nucleon and its variation with mass number; nuclear fission; nuclear fusion.

Unit IX: Electronic Devices **15 Periods**

Chapter-14: Semiconductor Electronics: Materials, Devices and Simple Circuits

Energy bands in conductors; semiconductors and insulators (qualitative ideas only)

Semiconductor diode - I-V characteristics in forward and reverse bias; diode as a rectifier;

Special purpose p-n junction diodes: LED, photodiode, solar cell and Zener diode and their characteristics; zener diode as a voltage regulator.

Junction transistor; transistor action; characteristics of a transistor and transistor as an amplifier (common emitter configuration); basic idea of analog and digital; signals Logic gates (OR, AND, NOT, NAND and NOR).

Unit X: Communication Systems **10 Periods**

Chapter-15: Communication Systems

Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation, satellite communication. Need for modulation, amplitude modulation.

PRACTICALS **(Total Periods 60)**

The record to be submitted by the students at the time of their annual examination has to include:

- Record of at least 15 Experiments [with a minimum of 6 from each section], to be performed by the students.
- Record of at least 5 Activities [with a minimum of 2 each from section A and section B], to be demonstrated by the teachers.
- The Report of the project to be carried out by the students.

Evaluation Scheme

Time Allowed: Three hours **Max. Marks: 30**

Two experiments one from each section	8+8 Marks
Practical record [experiments and activities]	6 Marks
Investigatory Project	3 Marks
Viva on experiments, activities and project	5 Marks
Total	**30 marks**

SECTION–A

Experiments

1. To determine resistance per cm of a given wire by plotting a graph for potential difference versus current.
2. To find resistance of a given wire using metre bridge and hence determine the resistivity (specific resistance) of its material.
3. To verify the laws of combination (series) of resistances using a metre bridge.
4. To verify the laws of combination (parallel) of resistances using a metre bridge.
5. To compare the EMF of two given primary cells using potentiometer.
6. To determine the internal resistance of given primary cell using potentiometer.
7. To determine resistance of a galvanometer by half-deflection method and to find its figure of merit.
8. To convert the given galvanometer (of known resistance and figure of merit) into a voltmeter of desired range and to verify the same.
9. To convert the given galvanometer (of known resistance and figure of merit) into an ammeter of desired range and to verify the same.
10. To find the frequency of AC mains with a sonometer.

Activities
(For the purpose of demonstration only)

1. To measure the resistance and impedance of an inductor with or without iron core.
2. To measure resistance, voltage (AC/DC), current (AC) and check continuity of a given circuit using multimeter.
3. To assemble a household circuit comprising three bulbs, three (on/off) switches, a fuse and a power source.
4. To assemble the components of a given electrical circuit.
5. To study the variation in potential drop with length of a wire for a steady current.
6. To draw the diagram of a given open circuit comprising at least a battery, resistor/rheostat, key, ammeter and voltmeter. Mark the components that are not connected in proper order and correct the circuit and also the circuit diagram.

SECTION-B

Experiments

1. To find the value of *v* for different values of *u* in case of a concave mirror and to find the focal length.

2. To find the focal length of a convex mirror, using a convex lens.
3. To find the focal length of a convex lens by plotting graphs between *u* and *v* or between *1/u* and *1/v*.
4. To find the focal length of a concave lens, using a convex lens.
5. To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation.
6. To determine refractive index of a glass slab using a travelling microscope.
7. To find refractive index of a liquid by using convex lens and plane mirror.
8. To draw the I-V characteristic curve for a p-n junction in forward bias and reverse bias.
9. To draw the characteristic curve of a zener diode and to determine its reverse break down voltage.
10. To study the characteristic of a common - emitter *npn* or *pnp* transistor and to find out the values of current and voltage gains.

Activities

(For the purpose of demonstration only)

1. To identify a diode, an LED, a transistor, an IC, a resistor and a capacitor from a mixed collection of such items.
2. Use of multimeter to (i) identify base of transistor, (ii) distinguish between npn and pnp type transistors, (iii) see the unidirectional flow of current in case of a diode and an LED, (iv) check whether a given electronic component (e.g., diode, transistor or IC) is in working order.
3. To study effect of intensity of light (by varying distance of the source) on an LDR.
4. To observe refraction and lateral deviation of a beam of light incident obliquely on a glass slab.
5. To observe polarization of light using two Polaroids.
6. To observe diffraction of light due to a thin slit.
7. To study the nature and size of the image formed by a (i) convex lens, (ii) concave mirror, on a screen by using a candle and a screen (for different distances of the candle from the lens/mirror).
8. To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses.

Suggested Investigatory Projects

1. To study various factors on which the internal resistance/EMF of a cell depends.
2. To study the variations in current flowing in a circuit containing an LDR because of a variation in

   (a) the power of the incandescent lamp, used to 'illuminate' the LDR (keeping all the lamps at a fixed distance).
   (b) the distance of a incandescent lamp (of fixed power) used to 'illuminate' the LDR.
3. To find the refractive indices of (a) water (b) oil (transparent) using a plane mirror, an equi convex lens (made from a glass of known refractive index) and an adjustable object needle.
4. To design an appropriate logic gate combination for a given truth table.
5. To investigate the relation between the ratio of (i) output and input voltage and (ii) number of turns in the secondary coil and primary coil of a self designed transformer.
6. To investigate the dependence of the angle of deviation on the angle of incidence using a hollow prism filled one by one, with different transparent fluids.

7. To estimate the charge induced on each one of the two identical styrofoam (or pith) balls suspended in a vertical plane by making use of Coulomb's law.
8. To set up a common base transistor circuit and to study its input and output characteristic and to calculate its current gain.
9. To study the factor on which the self inductance of a coil depends by observing the effect of this coil, when put in series with a resistor/(bulb) in a circuit fed up by an A.C. source of adjustable frequency.
10. To construct a switch using a transistor and to draw the graph between the input and output voltage and mark the cut-off, saturation and active regions.
11. To study the earth's magnetic field using a tangent galvanometer.

Practical Examination for Visually Impaired Students of Classes XI and XII
Evaluation Scheme

Time Allowed: Two hours **Max. Marks: 30**

Identification/Familiarity with the apparatus	5 marks
Written test (based on given/prescribed practicals)	10 marks
Practical Record	5 marks
Viva	10 marks
Total	**30 marks**

General Guidelines

- The practical examination will be of two hour duration.
- A separate list of ten experiments is included here.
- The written examination in practicals for these students will be conducted at the time of practical examination of all other students.
- The written test will be of 30 minutes duration.
- The question paper given to the students should be legibly typed. It should contain a total of 15 practical skill based very short answer type questions. A student would be required to answer any 10 questions.
- A writer may be allowed to such students as per CBSE examination rules.
- All questions included in the question papers should be related to the listed practicals. Every question should require about two minutes to be answered.
- These students are also required to maintain a practical file. A student is expected to record at least five of the listed experiments as per the specific instructions for each subject. These practicals should be duly checked and signed by the internal examiner.
- The format of writing any experiment in the practical file should include aim, apparatus required, simple theory, procedure, related practical skills, precautions etc.
- Questions may be generated jointly by the external/internal examiners and used for assessment.
- The viva questions may include questions based on basic theory/principle/concept, apparatus/ materials/chemicals required, procedure, precautions, sources of error etc.

Class XII

A. Items for Identification/ familiarity with the apparatus for assessment in practicals (All experiments)

Meter scale, general shape of the voltmeter/ammeter, battery/power supply, connecting wires, standard resistances, connecting wires, voltmeter/ammeter, meter bridge, screw gauge, jockey Galvanometer, Resistance Box, standard Resistance, connecting wires, Potentiometer, jockey, Galvanometer, Lechlanche cell, Daniell cell (simple distinction between the two vis-à-vis their outer (glass and copper) containers), rheostat connecting wires, Galvanometer, resistance box, Plug-in and tapping keys, connecting wires battery/power supply, Diode, Transistor, IC, Resistor (Wire-wound or carbon ones with two wires connected to two ends), capacitors (one or two types), Inductors, Simple electric/electronic bell, battery/power supply, Plug-in and tapping keys, Convex lens, concave lens, convex mirror, concave mirror, Core/hollow wooden cylinder, insulated wire, ferromagnetic rod, Transformer core, insulated wire.

B. List of Practicals

1. To determine the resistance per cm of a given wire by plotting a graph between voltage and current.
2. To verify the laws of combination (series/parallel combination) of resistances by ohm's law.
3. To find the resistance of a given wire using a meter bridge and hence determine the specific resistance (resistivity) of its material.
4. To compare the e.m.f of two given primary cells using a potentiometer.
5. To determine the resistance of a galvanometer by half deflection method.
6. To identify a
   - (i) diode, transistor and IC
   - (ii) resistor, capacitor and inductor, from a mixed collection of such items.
7. To understand the principle of (i) a NOT gate (ii) an OR gate (iii)an AND gate and to make their equivalent circuits using a bell and cells/battery and keys /switches.
8. To observe the difference between
   - (i) a convex lens and a concave lens
   - (ii) a convex mirror and a concave mirror and to estimate the likely difference between the power of two given convex /concave lenses.
9. To design an inductor coil and to know the effect of
   - (i) change in the number of turns
   - (ii) introduction of ferromagnetic material as its core material on the inductance of the coil.
10. To design a (i) step up (ii) step down transformer on a given core and know the relation between its input and output voltages.

Note: The above practicals may be carried out in an experiential manner rather than recording observations.

Prescribed Books:

1. Physics, Class XI, Part -I and II, Published by NCERT.
2. Physics, Class XII, Part -I and II, Published by NCERT.
3. The list of other related books and manuals brought out by NCERT (consider multimedia also).

PHYSICS (Code No. 042)
QUESTION PAPER DESIGN
CLASS - XII (2016-17)

Time 3 Hours | Max. Marks: 70

S. No.	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer-I (SA-I) (2 marks)	Short Answer -II (SA-II) (3 marks)	Value based question (4 marks)	Long Answer (LA) (5 marks)	Total Marks	% Weightage
1.	**Remembering - (Knowledge based** Simple recall questions, to know specific facts, terms, concepts, principles, or theories, Identify, define, or recite, information)	2	1	1	-	-	7	10%
2	**Understanding - (Comprehension** -to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	-	2	4	-	1	21	30%
3	**Application** - (Use abstract information in concrete situation, to apply knowledge to new situations, Use given content to interpret a situation, provide an example, or solve a problem)	-	2	4	-	1	21	30%
4	**Higher Order Thinking Skills - (Analysis & Synthesis-** Classify, compare, contrast, or differentiate between different pieces of information, Organize and/or integrate unique pieces of information from a variety of sources)	2	-	1	-	1	10	14%
5	**Evaluation** - (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	1	-	2	1	-	11	16%
	TOTAL	**5x1=5**	**5x2=10**	**12x3=36**	**1x4=4**	**3x5=15**	**70(26)**	**100%**

SUPERPOSITION OF WAVES

Introduction :

Waves are created by a simple harmonic oscillation, and thus have a sinusoidal shape. When only one wave passes through a region the study is not very complex. But when many waves pass simultaneously the interaction between them brings in complex situations. The rules for adding waves are quite simple as we consider their phase and the momentary displacement. In water waves, at an instant of time the 'height' of the water varies with distance from a vibration source, and at each point on the water's surface the height varies with time. The study of their interaction is done using the idea of superposition principle.

Learning outcomes

1. Understands the idea of interaction.
2. Learns to apply Superposition principle mathematically.
3. Tries to understand the conditions under which the interactions become prominent.
4. Distinguishes the conditions of superposition with regard to different waves.
5. Appreciates the difference in the different forms of interaction.
6. Recalls the experience with regard to light and sound Waves interaction.

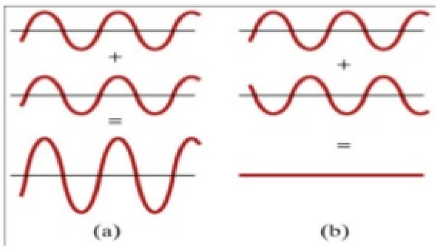
7. Learns to show the interaction pictorially.

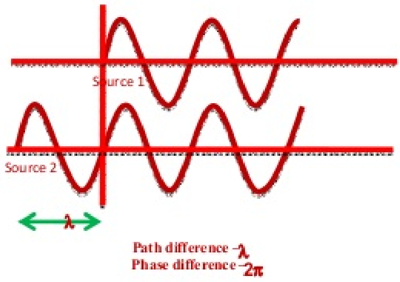
8. Appreciates the final outcome.

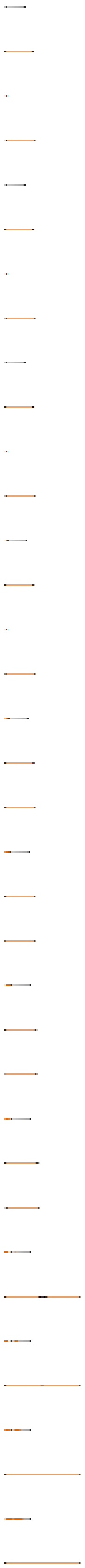
Principle of Linear Superposition

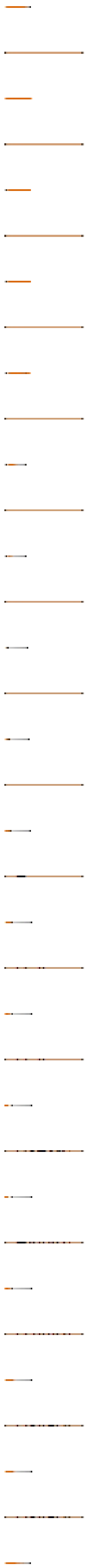
When two or more waves are passing through a position simultaneously, the resultant disturbance/displacement is the sum of the displacement caused by the individual waves.

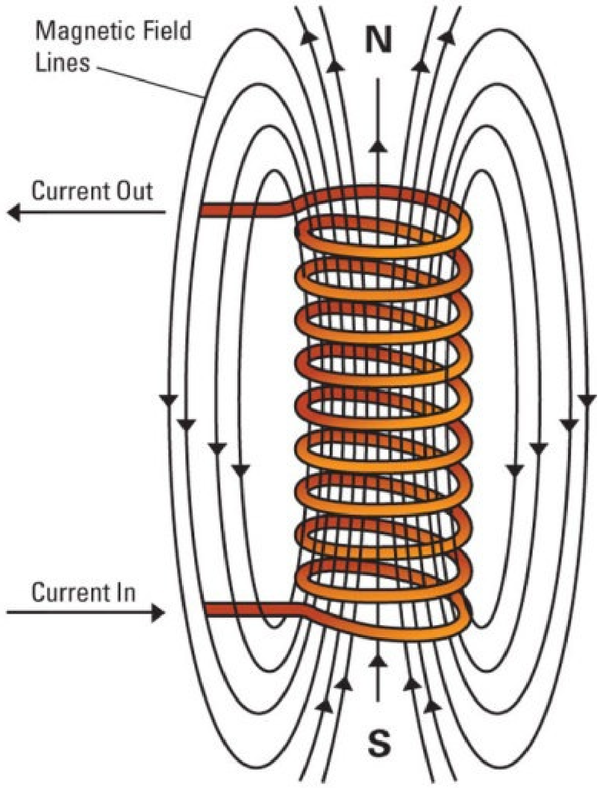
$$y = y_1 + y_2 + y_3 + y_4 + \ldots\ldots\ldots$$











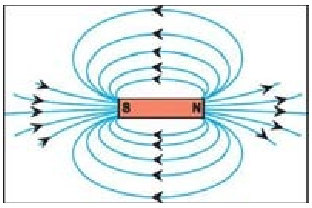
Permanent magnets are made from "hard" ferromagnetic materials such asalnico and ferrite that are subjected to special processing in a powerful magnetic field during manufacture, to align their internalmicrocrystalline structure, making them very hard to demagnetize. To demagnetize a saturated magnet, a certain magnetic field must be applied, and this threshold depends on coercivity of the respective material. "Hard" materials have high coercivity, whereas "soft" materials have low coercivity.

An electromagnet is made from a coil of wire that acts as a magnet when an electric current passes through it but stops being a magnet when the current stops. Often, the coil is wrapped around a core of "soft" ferromagnetic material such as steel, which greatly enhances the magnetic field produced by the coil.

It is concentrated near (and especially inside) the coil, and its field lines are very similar to those of a bar magnet. The orientation of this effective magnet is determined by the right hand rule. The magnetic moment and the magnetic field of the electromagnet are proportional to the number of loops of wire, to the cross-section of each loop, and to the current passing through the wire.

The overall strength of a magnet is measured by its magnetic moment or, alternatively, the total magnetic flux it produces. The local strength of magnetism in a material is measured by its magnetization.

8



Uses for electromagnets include particle accelerators, electric motors, junkyard cranes, and magnetic resonance imaging machines etc.

Understanding the Units and calculations

In all units, it is convenient to employ two types of magnetic field, B and H, as well as the magnetization M, defined as the magnetic moment per unit volume.

The SI unit of magnetic induction or field B is tesla(T) or weber/meter^2(Wb/m^2). In CGS, the unit of B is the gauss (G). One tesla equals 10^4 G.

In SI units, the relation $B = \mu_0(H + M)$ holds, where μ_0 is the permeability of space, which equals $4\pi\times10^{-7}$ Tm/A. In CGS, it is written as $B = H + 4\pi M$.

Materials that are not permanent magnets usually satisfy the relation $M = \chi H$. In S.I.

where χ is the (dimensionless) magnetic susceptibility. For materials satisfying $M = \chi H$, we can also write $B = \mu_0(1 + \chi)H = \mu_0 \mu_r H = \mu H$, where $\mu_r = 1 + \chi$ is the (dimensionless) relative permeability and $\mu = \mu_0\mu_r$ is the magnetic permeability.

For a bar magnet of cross-section *A* with uniform magnetization *M* along its axis, the pole strength is given by *q* =

m

MA, so that *M* can be thought of as a pole strength per unit area.

Magnetic flux density

The magnetic flux density (also called magnetic **B** field or just magnetic field, usually

denoted **B**) is a vector field. The magnetic **B** fieldvector at a given point in space is specified by two properties:

Its direction, which is along the orientation of a compass needle.

Its magnitude, which is proportional to extent a compass needle orients alonga particular direction.

Magnetic moment

A magnet's magnetic moment also called magnetic dipole moment (***q***) is a vector that

m

characterizes the magnet's overall magnetic properties. For a bar magnet, the direction of the magnetic moment points from the magnet's south pole to its north pole. In SI units, the magnetic moment is specified in terms of A**.** m2.

A magnet of pole strength m and pole separation 2 ***l*** is to have a magnetic moment

q = 2

m

l m in Ampere metre.

A wire in the shape of a circle with area *A* and carrying current *I* is a magnet, with amagnetic moment of magnitude equal to ***IA in*** Ampere square metre.

Magnetization

9

The magnetization of a magnetized material is magnetic moment per unit volume, usually denoted by **M**, with SI unit A/m. It is a vector field, rather than just a vector as different areas in a magnet can be magnetized with different directions and strengths because of domains.

Magnetic materials

The overall magnetic behaviour of a material can vary widely, depending on the structure of the material, particularly on its electron configuration. Several forms of magnetic behaviour have been observed in different materials, including:

Ferromagnetic and ferrimagnetic materials are the ones normally thought of as magnetic as they are attracted to a magnet strongly enough that the attraction can be felt. These materials are the only ones that can retain magnetism after magnetization. Ferrimagnetic materials including ferrites and the oldest magnetic materials magnetite and lodestone, are similar to but weaker than ferromagnetics. The difference between ferro- and ferrimagnetic materials is related to their microscopic structure.

Paramagnetic substances, such as platinum, aluminum, and oxygen, are weakly attracted to either pole of a magnet.

Diamagnetic means repelled by both poles. Compared to paramagnetic and ferromagnetic substances, diamagnetic substances, such as carbon, copper, water, and plastic, are even more weakly repelled by a magnet. The permeability of diamagnetic materials is less than the permeability of a vacuum.

Important magnetic properties of diamagnetic, paramagnetic and ferromagnetic substances.

S.No.

Test/Parameter/Value Diamagnetic

Paramagnetic

Materials

Materials

Ferromagnetic

Materials

1.

In Non-uniform Field

towards Weak field

towards moderate

towards the strongest

tends to shift

field

field

2.

In Uniform Field

Weakly repelled by a

Weakly attracted by

Strongly attracted by

magnet.

a magnet.

a magnet.

3.

Magnetisation/Flow of

Weakly magnetised

Weakly magnetised

Strongly magnetised

lines

and lines are expelled

in the direction of

in the direction of

field

field

4.

Magnetic Permeability

Slightly less than 1

Slightly more than 1. has a very high value.

μ_r

5.

Susceptibility χ

Small negative value

Small positive value

Large positive value

m

6.

Dependence on

No Change

Inversely dependent

Inversely dependent

Temperature

on Absolute

on Absolute

Temperature

Temperature

10

-

-

-

-

-

-

-

-

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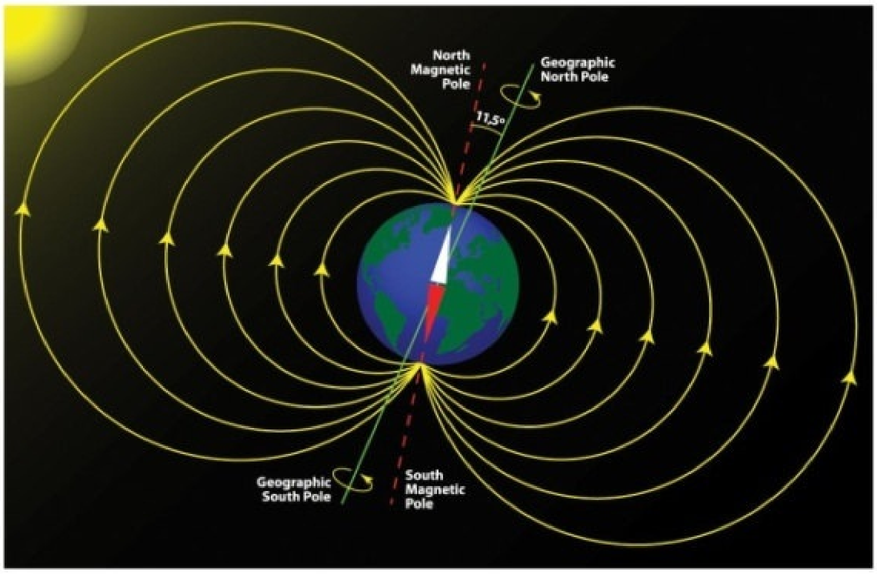
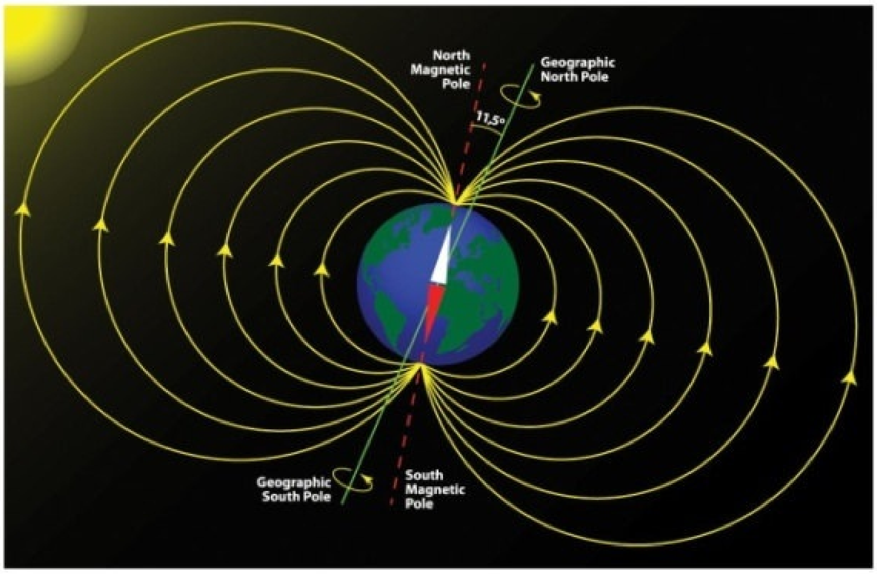


North
Magnetic
Pole
Geographic
North Pole
11,5°
Geographic
South Pole
South
Magnetic
Pole


North
Magnetic
Pole
Geographic
North Pole
11.5°
Geographic
South Pole
South
Magnetic
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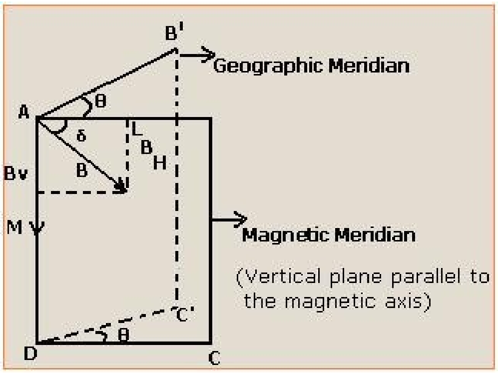

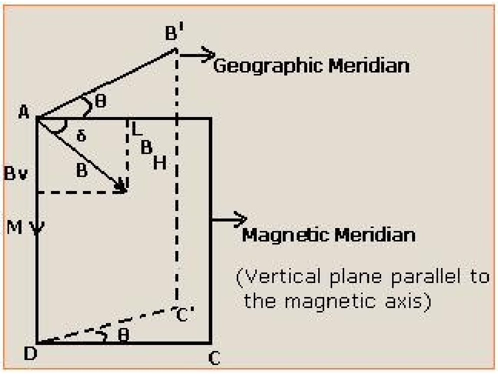

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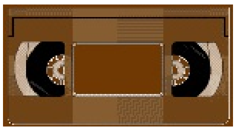
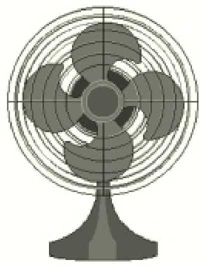




Activity 1

INTRODUCTION TO THE MYSTERY OF MAGNETISM

Each time you turn on a light, listen to your stereo, fly in an airplane, or watch TV, you are depending on the principles of magnetism to work for you. Take a look at the pictures below. All of the items in these pictures have something to do with magnetism.

Hydroelectric

Video Cassette Tape

Dam

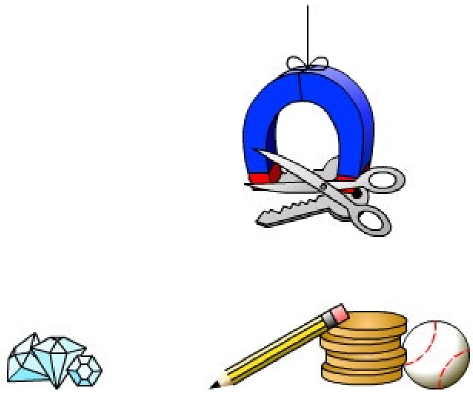
Magnetic Particle

Fan-

Inspection Unit

Airplane Navigational Panel

- Do you know how your life might be different without these?
- What do you think magnetism has to do with each of these things?
- Think about these questions as you explore these materials on magnetism.



Activity 2

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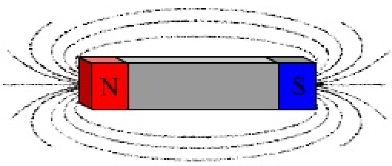
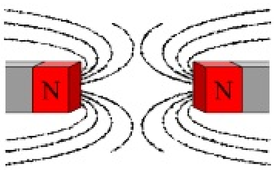




Box A

Box B

Box C

Questions

1. What is happening when iron particles are sprinkled over and around the magnets?

2. Do you see any differences in the patterns in each of the three situations? If so, what differences do you see?

3. What do the patterns indicate in each situation?

4. Can you tell by these patterns where the magnetic forces might be the strongest? The weakest?

5. Can you tell by these patterns where the magnetic forces are attracting? Repelling?

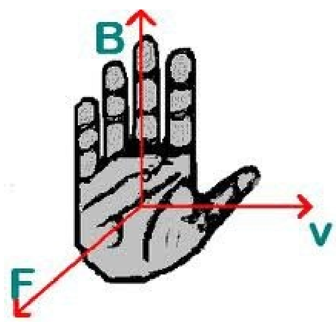
Discussion/ Observations

What does the pattern made by the iron particles indicate?

You learned in a previous experiment that no matter how many pieces you cut a magnet into, each piece is still a magnet. Even if you shred a magnet into particles the size of sand, each tiny grain is a magnet with a north pole and a south pole. When these magnetized particles are sprinkled over the magnet in Box A, the resulting pattern shows the magnetic field around a single magnet. We can see that the force of the magnet is the strongest at the two ends because more iron particles are concentrated in these areas. The magnetic lines of flux flow from one end to the other.

How do you explain what is occurring?

To understand what is happening, recall from a previous experiment that a magnet allowed to stand freely, like a compass needle, will point to the north in response to the earth's magnetic field unless it is near a strong magnetic. If the compass is near a strong bar magnet, the opposite poles of the magnets are attracted to each other. We can use this knowledge to identify the magnetic field of a magnet by placing a compass at various locations around the bar magnet and observing where the compass needle points. If the compass is far away from the bar magnet the compass will always point north because it is not in the bar magnet's magnetic field. As it gets closer to the magnet, the compass begins to point more and more toward the magnet as a result of the force, or the magnetic field, of the magnet. The compass needle aligns itself with the magnetic flux lines of the magnet.



What if...

Let's say that instead of using one compass to move around the bar magnet, we place thousands of tiny compass needles all around the bar magnet and watch which direction they point and what pattern they make. That is what is happening in our experiment with the iron filings. Each tiny magnetic iron filing is a tiny magnet with a north and south pole, just like a tiny compass. When the iron filings are sprinkled, those very close to the magnet, where the magnetic force is the strongest, will cling to the magnet. Those filings a little farther away, where the magnetic force is less strong, will align themselves with the magnetic flux lines, but they will not be drawn to cling to the magnet. Those filings even farther away, outside the magnetic force, will point north in response to the earth's magnetic field. These patterns formed by the direction of the tiny compasses can tell us something about where the magnetic force is the strongest, where it is an attracting force, and where it is a repelling force. In Box B, this pattern indicates a repelling force because the tiny magnets are moving away from the ends of the larger bar magnets. Looking at the pattern in Box C, you see that the two ends of these magnets are attracted because the tiny magnets appear to be lined end to end, attracting to one another and also attracting to the ends of the larger bar magnets.

Practice questions/problems

1. How are the magnetic and electric forces similar and different?

2. List some differences between the electric and magnetic fields.

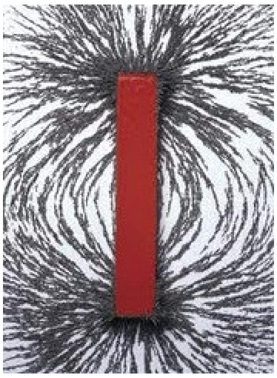
3. How does a compass behave as you move it around a magnet. A compass aligns itself with the magnetic field lines. Draw a magnet and the field lines around it using the compass as a guide.

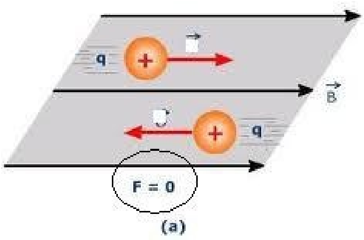
4. If you break a magnet in to two equal portions – i) along the length and ii) perpendicular to the length, what will be the outcome?

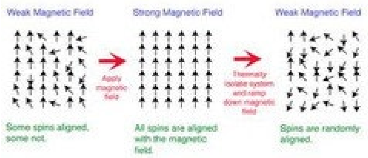
5. Answer/discuss the following questions using the given situation-

i) A force that forms a 90 degree angle with another vector

15







ii)

The area around a magnet that affects all other magnetic objects

iii)

A force that is in the same direction as another vector

iv)

Magnet that can lose it magnetism when taken out of a magnetic field

V)

Unit for magnetism

16

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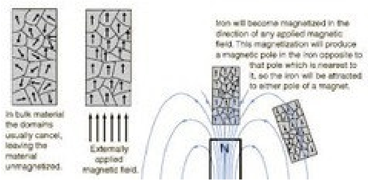
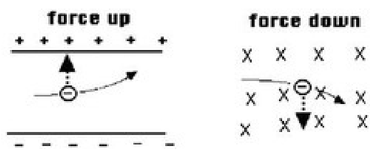
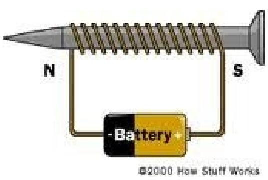






vi)

cluster of atoms whose magnetic fields are all in alignment

vii) A force that slightly changes the direction of a charge moving in a field

a.

viii) The current carrying coil of wire

Conclusive Remarks

Learners investigate the phenomenon of magnetism. They investigate the properties of magnets by experimenting with how magnets affect each other and which materials are affected by them. learners look for patterns and explain their observations. Students design and make items that make use of these properties such as magnetic fish games, toys or a compass. Throughout their investigations learners develop and apply their science-specific language including magnetic, non-magnetic, magnetism, repel and attract.

Resources

The following resources contain sections that may be useful when designing learning experiences:

Websites

- Magnetis – an explanation of magnetism for teachers
- Exploratorium: Science Snacks: Magnetic lines of force – activities with magnets.
- BBC – Schools – KS2 Bitesize Revision – Science – Magnets and springs activities with magnets and springs.

17

FUN WITH SIMPLE PENDULUM

Introduction

A pendulum is a mass *suspended from a pivot so that it can swing freely. When a pendulum is displaced sideways from its resting equilibrium* position *, it is subjected to a restoring force that will accelerate it back to words the equilibrium position. When released, the restoring force combined with the pendulum's mass causes it to oscillate about the equilibrium position, swinging back and forth. An oscillation in which the restoring force is proportional to the displacement alone is called Simple Harmonic.*

LEARNING OUT COME

1. Understands the condition to be satisfied for a Pendulum to have Simple Harmonic motion.

2. Identifies the parameters that affect the period of a simple pendulum.

3. Estimates the Time period and thereby the value of Acceleration due to gravity.

4. Understands the importance of COM and the way to find the length of the pendulum

5. Understands and applies in practical the small angle conditions

KEY POINTS

• Length of the pendulum = Distance from the point of suspension to the Centre of mass of the bob

• Pendulum is Simple Harmonic only for small angles (say <15º)

• Without restoring force Oscillation is not possible.

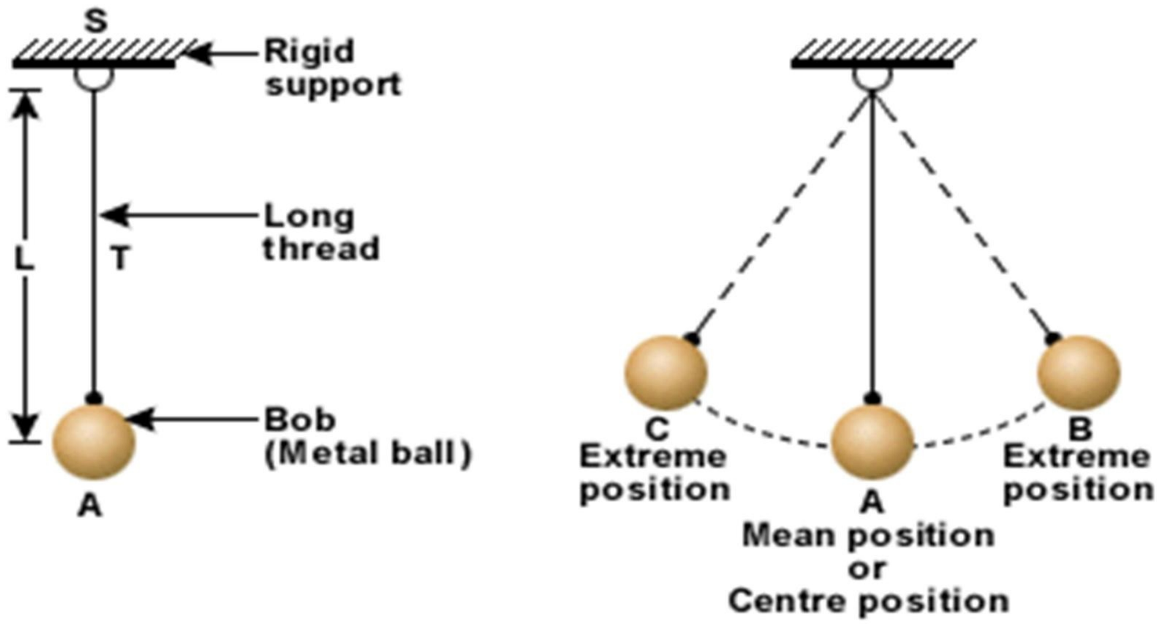
Conceptual Understanding

To and fro motion of an object about a fixed position is called oscillatory motion. The oscillatory motion of a simple pendulum gives us one possible provision to calculate acceleration due to gravity. If a mass is suspended at the end of a string, the arrangement is called Simple pendulum.

Galileo was the first one to observe the dependency of Time Period (time taken for one complete oscillation) on the length of the pendulum.

The other parameter involved is acceleration due to gravity (g= 9.8 m/s2 on the surface of Earth).

18



(a) Simple pendulum (b) Motion of a simple pendulum

Under smal angle conditions, the frequency and time period of the simple pendulum is independent of mass and initial angular displacement.

Time period of a simple pendulum is given be the relation

T= 2π√(l/g)

i.e for pendulums having bobs of different masses and given different initial angular displacements the time period wil be identical for the same length.

Way to Perform:

The period T of a simple pendulum (measured in seconds) is given by the formula:

$T=2\pi\sqrt{(l/g)}$ (1)

Acceleration due to gravity g can be expressed as $g = 4\pi^2 l/T2$

1.

Measure and record the length of the pendulum – Point of suspension to the centre of the pendulum bob.

2.

Set the pendulum in S.H.M until it completes (say 30 oscil ations), taking care to record the time taken. Then the period T for one oscil ation is just the time recorded divided by (say30) the number of oscil ations

3.

You wil make a total of eight measurements for g using two different masses and four different length l.

Note: $\pi = 3.14$, $4\pi^2 = 39.44$

Length(*l*)

Mass

Time for

T

T2

g=

(say30)

39.94 *l*/T2

Time

oscillations

period

To observe and thus verify dependence of time period of simple pendulum on mass and length:

EXAMPLE - Measuring Acceleration due to Gravity using the Period of a Pendulum.

What is the acceleration due to gravity in a region where a simple pendulum having a length 75.000 cm has a period of 1.7357 s

Strategy: We are asked to find g given the period T and the length L of a pendulum. We can solve for g, assuming only that the angle of deflection is less than 15º.

Solution 1. Square and solve for g:

2. Substitute known values into the new equation:

3. Calculate to find g: Discussion: This method for determining g can be very accurate.

This is why length and period are given to five digits in this example. For the precision of the approximation sin θ to be better than the precision of the pendulum length and period, the maximum displacement angle should be kept below about 0.5º.

Activities:

Activity 1

Taking a string of a particular length:

Take a metallic bob of some radius.

Take tennis ball of the same radius.

Take a crushed paper ball of the same radius.

Record your Observations

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Activity 2

Taking a particular metallic bob of some radius:

Take string of some length ‘l’

Take string of length ‘l/2’

Take string of length ‘3l/4’

Record your Observations

Activity 3

Hang a small bucket filled with water having a piercing near bottom to a string and let it oscillate with small initial angular displacement. What will be the change in time period as the water flows out of the bucket?

Record your Observations

Practice Questions

1. Ask the students to explain which factors *might* affect the period of a pendulum.
(Answer: Pendulum length, bob weight, angle pendulum swings through.)
2. Why does the mass not make a difference? (Answer: Because the pendulum, just like falling objects, is not dependent on weight.)
3. How does the length of a pendulum's string affect its period?
(Answer: A pendulum with a longer string has a longer period, meaning it takes a longer time to complete one back and forth cycle when compared with a pendulum with a shorter string. Also, the pendulum with the longer string has a lower frequency, which means it completes less back and forth cycles in a given amount of time as compared with a pendulum with a shorter string.)
4. Why does the angle the pendulum starts at not affect the period?
(Answer: Because pendulums that start at a bigger angle have longer to speed up, so they travel faster than pendulums that start at a small angle.)

Conclusive Remarks

Learners will explore how a pendulum work and why they are useful in everyday applications. In a hands-on activity, they experiment with string length, pendulum weight and angle of release. In an associated literacy activity, students explore the mechanical concept of rhythm, based on the principle of oscillation, in a broader biological and cultural context — in dance and sports, poetry and other literary forms, and communication in general.

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OPEN ENDED QUESTIONS

Introduction

This open ended questions are framed such that the teacher can bring in the changes in various parameters (as asked) involved and study how the changes affect the outcome of the other related parameters. The intrinsic parameters are to be understood to solve these questions. With change in value of these parameters multiple conclusion can be drawn. This will reflect up on the conceptual understanding of the learner which is expected to enhance the Teaching – Learning process in the Classroom Situation.

Learning Outcome

1. Tries to understand the given situation at micro-level.
2. Picturises the situation for all the objects involved.
3. Tries to relate with Physics in the given situation.
4. Recalls the mathematical tools
5. Applies the mathematical tools to the given situation.
6. Critically analyses the steps involved to simplify the steps wherever possible.
7. Understands the Physics through the thought that evolves in the group.
8. Appreciates the quick processing ability of the learner in the group and tries to imbibe such abilities.
9. Tries to develop the thought process that can be built up on in his/her lecturer to benefit the learner.
10. Learns to appreciate the grasp, scientific approach, logical thinking and feedback of the Learner.

Mode of Activity:

Teachers will be grouped in 6 or 7 members and will be assigned to do atleast 3 questions out of the six in a time of One hour. The same will be presented by the Team leader and the queries that evolve will be answered. The teacher facilitator will move among the groups to just give a helping hand without opening the complete answer. The facilitator is to finally make the teacher learner to grasp, think, execute, perform the task and enhance his skills for delivery in the classroom.

Problem 1 :Death Well

A mass is to be kept in contact with a vertical surface. Is it possible without any force? If so what is the condition? If not, why? If the vertical surface is rotated about an axis, will your answer change? Give reason. What can be the angular velocity so that the mass can stay at the same horizontal level? On increasing or decreasing the angular velocity what changes can be observed with the position of your mass? Do you come across a similar situation in real life? Give Example?

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Problem 2 : Slab over Slab

Two slabs of masses m1 and m2 are placed one above the other (m2 above) on a horizontal surface. If the coefficient of friction in each of the surfaces is not zero, how will you describe their motion as a force F is acted on m1 and m2(one at a time). In each case find the inequality conditions that can accelerate the bodies.

Problem 3: Moment of Inertia (I) of disc with different axis

A disc of mass M and radius R is given. What will be the moment of Inertia I about an axis perpendicular to the plane and passing through its centre? If a portion of radius R/2 is carved out of the same, how will the value of I change? If a thick portion of R/4 is cut from R/4 to 3R/4 from the centre will the answer differ?

Problem 4: Charging a sphere in different cases (Charge density σ, Potential V and Capacitance C)Two spheres A and B of radius r1 and r2 are charged.

If the charge densities are same

i)

What will be the Charge, Field, Potential at a point on their surface?

ii)

If connected by a conducting wire and disconnected, will your answer vary?

iii) What will be their values if changes?

If the radii of the spheres are the same will the answer be different? How and Why?

Problem 5: Dip, Declination – Earths Magnetism

What is Magnetic Meridian? How to set a magnetic needle in magnetic Meridian?

Why a needle dips down from the horizontal, when placed in Magnetic Meridian?

How do you express the angle of dip in terms of the Horizontal Component of Earth's field.

When the needle in Meridian is turned by an angle φ, will your dip angle change? Why?

If φ1and φ2 are the angle of dip in two perpendicular planes and φ is the true angle of dip, prove that the sum of the squares of the cot functions of φ1 and φ 2 is equal to the square of the cot function of φ.

Problem 6: Magnetic field at different places

Find the ratio of the magnetic field at the centre of the Circular loop as shown below.

i2

A

l

O

2

i

i1

l

i

1

B

If the point B is such that the angle AOB is θ, will your answer vary?

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If the wires in the smaller and the longer arc are different, will your answer change?

Give reason in both the cases.

If the same circular loop is made a square what will be the magnetic field at the centre of the square.

Hint/Steps to solve the Problems

Teachers are requested to try solving the questions with all variables possible before seeing the steps in the group to share their experiences in solving a Question.

1. Recall that the frame is non-inertial. There will be an equal and opposite reaction given by the frame on the mass in contact. Weight has to be balanced by only a vertical force. Reaction can exist even in the horizontal direction.

2. Apply a force on a mass. Indicate the forces on the other mass and check whether that can bring motion overcoming the frictional force. Repeat for the force being applied on the other mass.

3. Identify the axis and the value of I for a normal disc. Remember that the value I is based on the distribution of mass. As long as the axis is the same we can add an d subtract the values for different portions of the body. If axis varies one has to apply the Parallel or perpendicular axis theorem.

4. Whatever the condition given – satisfy the same. Work the relation for Radius and charge. The field and potential for a point on the surface can be found by considering

the charges to be at the centre.

5. Recall the definition that Magnetic Meridian is the vertical plane coinciding the North and South magnetic pole of the earth. Remember that the dip when the vertical plane of the needle is away from the magnetic meridian by φ is apparent dip δa and is given by

tanδa = (tan δ / Cosφ) where δ is the true angle of dip.

6. Field due to a portion of a circular loop is in proportion to the angle it subtends at the centre. Current will divide when multiple paths exist at any point. The current such formed depends on the resistance that means the length (arc).

Conclusive REMARKS

The attempt through these questions is to enhance the teaching process. The teacher is expected to incorporate the methods learned in solving the numerical questions during routine lecture and thereby make learning an enjoyable and a complete process. The joy of getting a correct answer to the questions by any student is unquestionably good.

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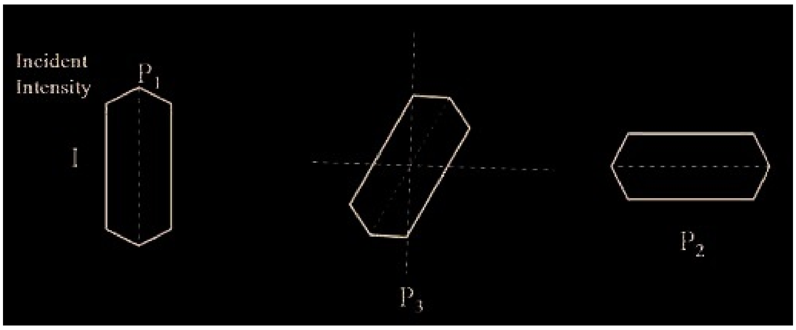
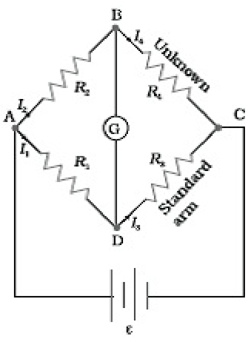
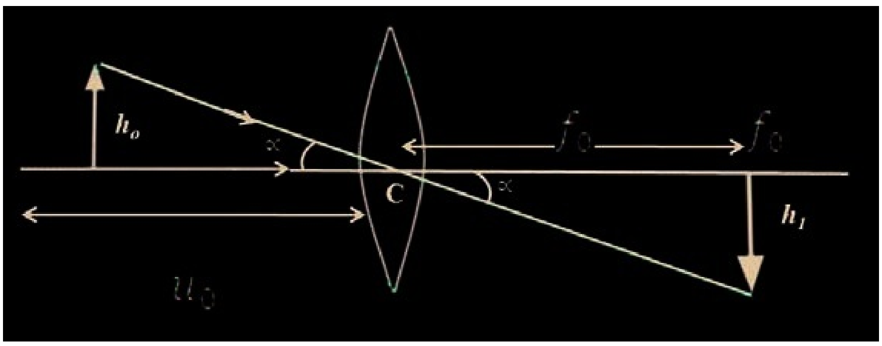
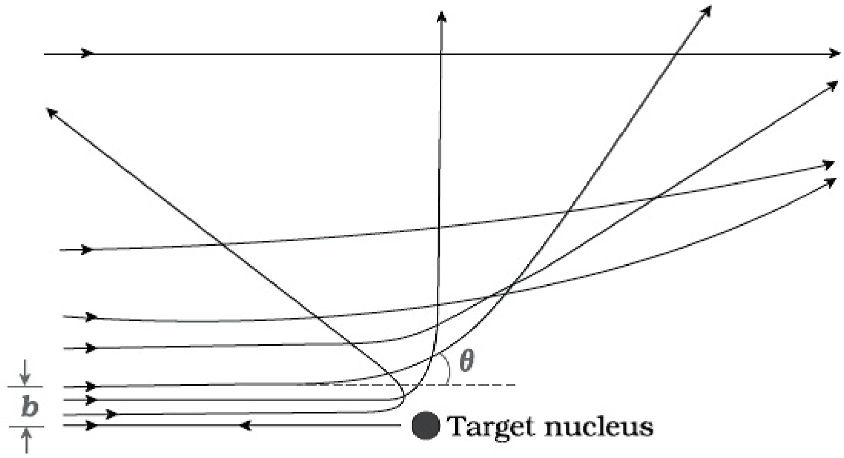
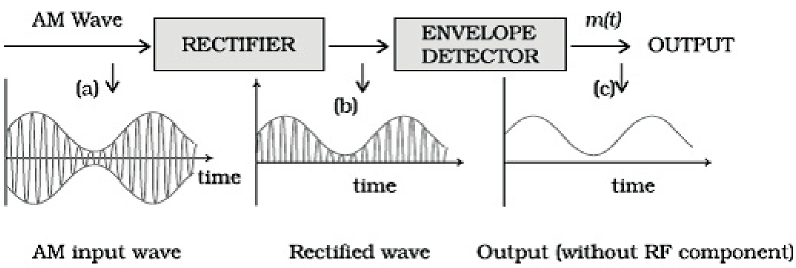
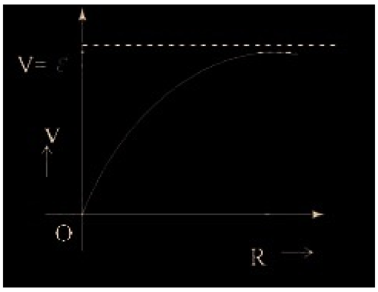







θ
b
Target nucleus


AM Wave
RECTIFIER
ENVELOPE DETECTOR
m(t)
OUTPUT
(a)
(b)
(c)
time
time
time
AM input wave
Rectified wave
Output (without RF component)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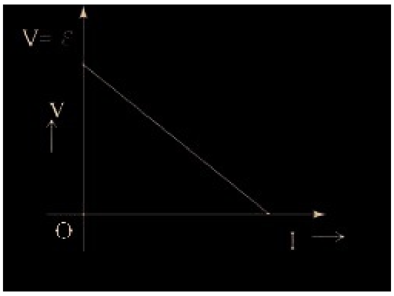
O
R


V= ε
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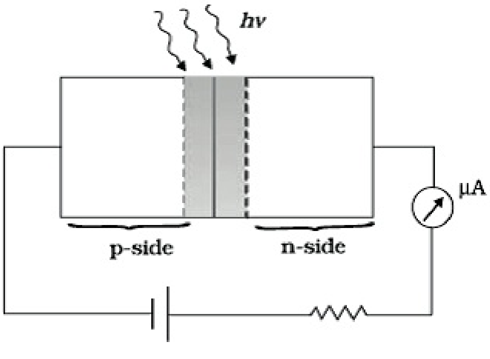
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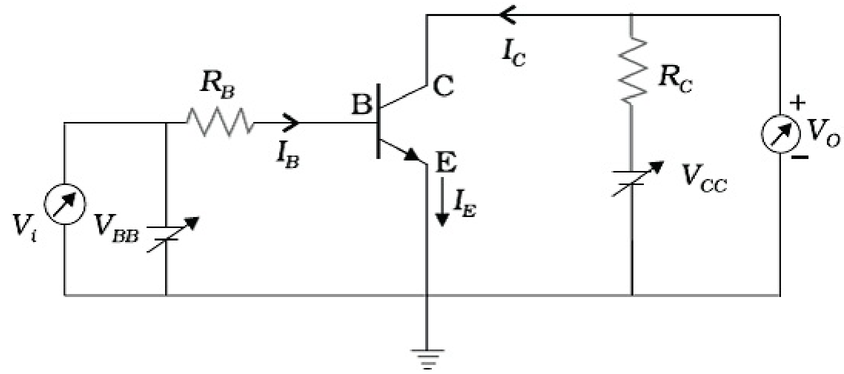

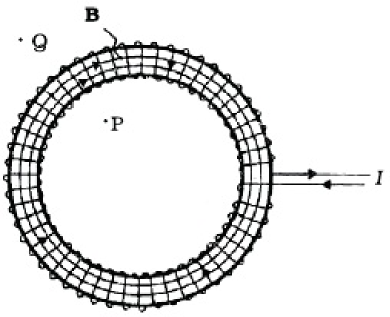

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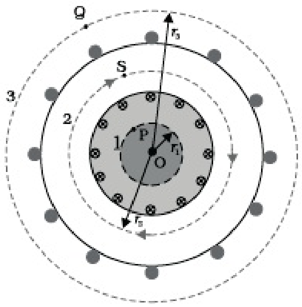

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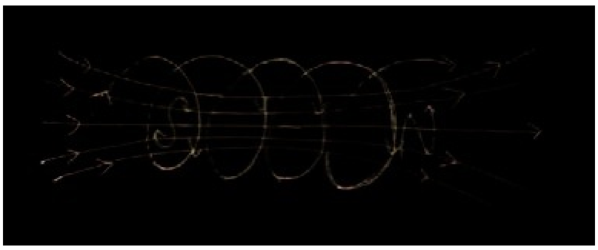

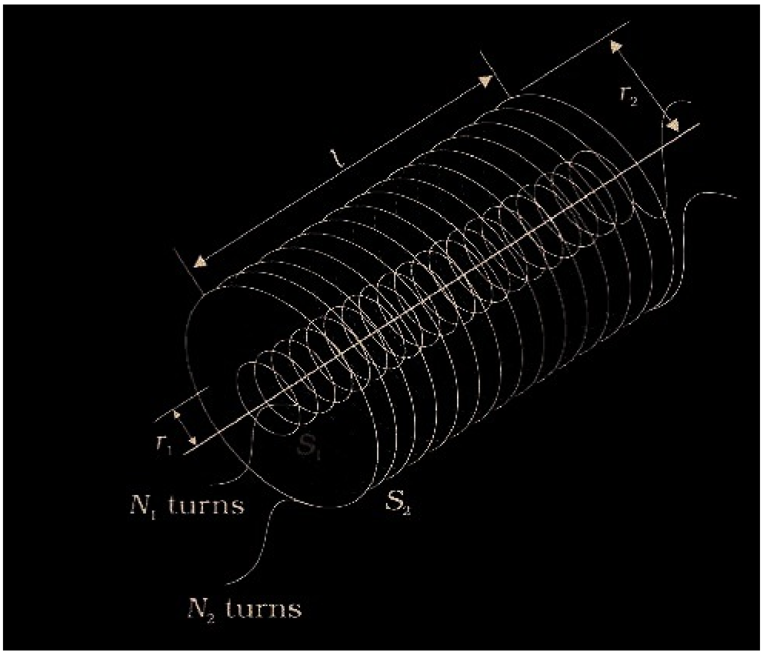
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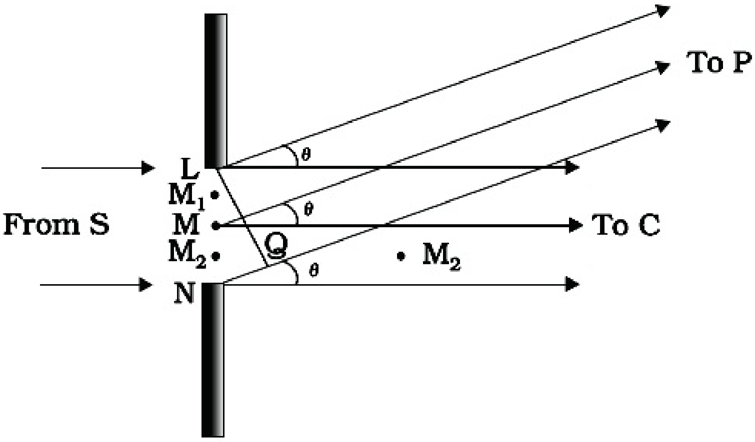
N_2 turns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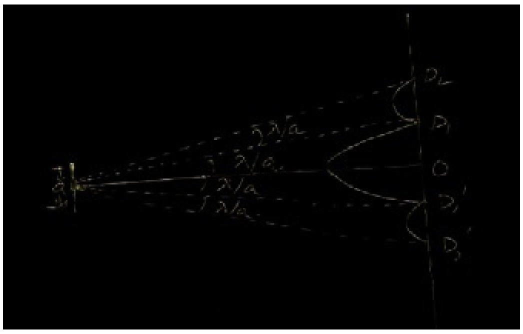

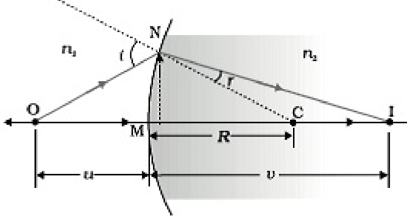
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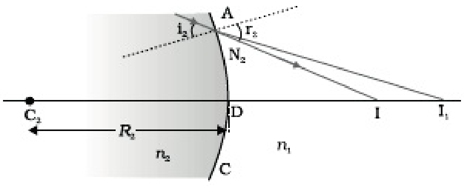
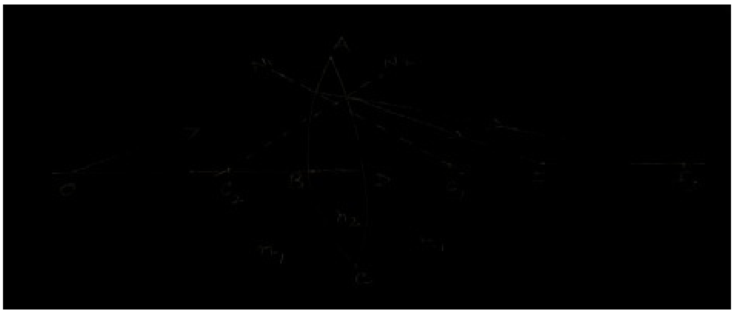
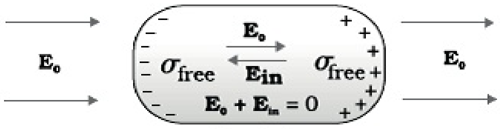
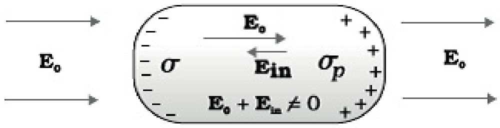






Conductor



Dielectric

Document Outline