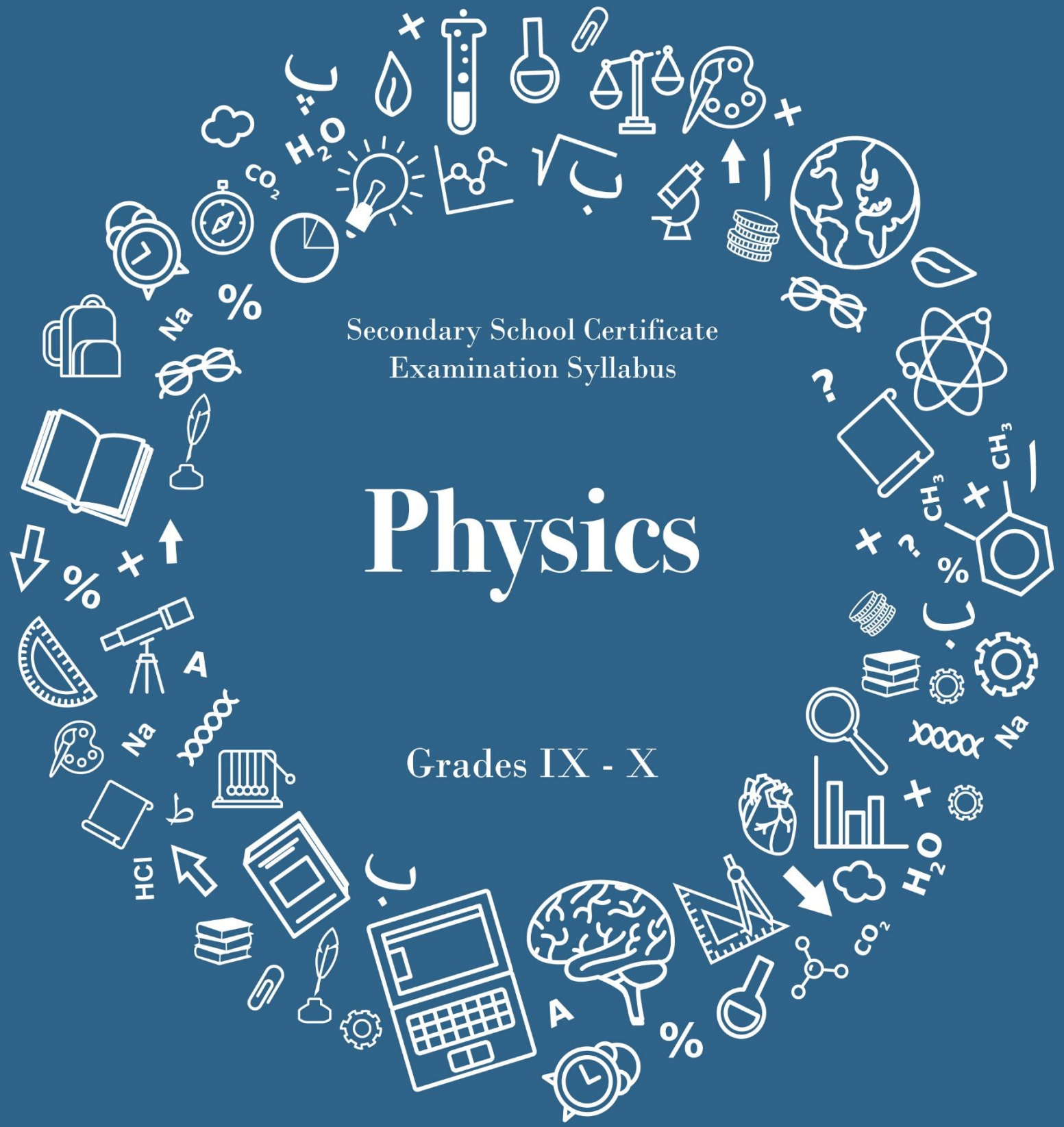
آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD



Secondary School Certificate
Examination Syllabus

Physics

Grades IX - X

(Based on New National Curriculum 2022-2023)

Student Learning Outcomes of AKU-EB SSC Physics Syllabus

Part I (Grade IX)

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level[1]		
				R	U	A and beyond
1. Measurement		Students should be able to:				
1.1	Physical Quantities	1.1.1	differentiate between physical and non-physical quantities;		*	
		1.1.2	exemplify that physics is based on physical quantities only;		*	
		1.1.3	identify various physical quantities as base and derive quantities;		*	
1.2	The International System (SI) of Units	1.2.1	list the seven base quantities of International System (SI) along with their symbols and units;	*		
		1.2.2	differentiate between base and derived physical quantities and units;		*	
1.3	Scientific Notation	1.3.1	convert prefixes and their symbols to indicate multiples and sub-multiples for base and derived units;			A
		1.3.2	convert numerical values of measurement in scientific notation;			A
1.4	Scalars and Vectors	1.4.1	differentiate between scalar and vector quantities;		*	
		1.4.2	list out various physical quantities as scalar or vector;	*		
		1.4.3	describe the 'head to tail' rule of vector addition;		*	
		1.4.4	determine, using Pythagoras theorem and graphs, the resultant of two vectors at right angle;			A

[1]R = Remember, U = Understand, A = Apply and beyond [Apply (A), Analyse (An), Evaluate (E), Create (C)]

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
1.5	Measuring Instruments • Measuring cylinder • Measuring tape • Meter rule • Physical/ Electronic balance • Screw gauge • Spring balance • Stopwatch • Vernier callipers	1.5.1 1.5.2 1.5.3 1.5.4	identify measuring instruments; determine the least count (LC) of the measuring instruments; describe the working of measuring instruments; determine an average value of the measurement by measuring multiples values of the quantity;		* * 	 A A
1.6	Error and Accuracy	1.6.1 1.6.2	identify sources of errors (systematic and random) in the measurement; differentiate between precision and accuracy;		* *	
1.7	Significant Figures	1.7.1 1.7.2	describe significant figures; apply the rules for rounding a number to the appropriate number of significant figures.		*	 A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
2. Kinematics		Students should be able to:				
2.1	Rest and Motion	2.1.1	define rest and motion;	*		
2.2	Types of Motion	2.2.1	differentiate among the different types of motion, i.e., translatory (linear, random, circular), rotatory and vibratory motion;		*	
2.3	Terms Associated with Motion	2.3.1	define the following terms: a. distance, b. displacement, c. speed, d. velocity, e. acceleration;	*		
		2.3.2	calculate average speed, average velocity and acceleration;			A
		2.3.3	differentiate between: a. distance and displacement, b. speed and velocity, c. average speed and instantaneous speed, d. uniform and non-uniform velocity, e. uniform and non-uniform acceleration;		*	
		2.3.4	describe the universal speed limit of any object in the universe that is approximately 3×10^8 m/s;		*	

Topics and Sub-Topics		Student Learning Outcomes	Cognitive level		
			R	U	A and beyond
2.4 Graphical Analysis of Motion	2.4.1	interpret distance-time graph and speed-time graph;			E
	2.4.2	determine the slope/ gradient of distance-time and speed-time graph;			A
	2.4.3	infer the following states of a body based on the given graph: a. at rest, b. moving with constant speed, c. moving with positive acceleration, d. moving with negative acceleration;			An
	2.4.4	calculate the area under the speed-time graph of uniformly accelerated objects to find out the distance covered by the objects;			A
2.5 Motion due to Gravity	2.5.1	define acceleration due to gravity;	*		
	2.5.2	solve word problems related to free-falling bodies using the relation $g = \Delta v / \Delta t$.			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
3. Dynamics		Students should be able to:				
3.1	Mass and Weight	3.1.1	differentiate between mass and weight;		*	
		3.1.2	explain that the mass of an object resists changes from its state of rest or motion (inertia);		*	
		3.1.3	define gravitational field strength;	*		
		3.1.4	solve word problems using the relation $w = mg$;			A
3.2	Force	3.2.1	describe the concept of force with its SI unit;		*	
		3.2.2	define contact and non-contact forces;	*		
		3.2.3	identify the following forces as contact and non-contact forces: a. air resistance, b. drag force (push, pull), c. electrostatic force, d. force of friction, e. gravitational force, f. magnetic force, g. tension (elastic force), h. thrust (driving force);		*	
		3.2.4	state four fundamental forces of nature in terms of their relative strength;	*		
		3.2.5	mention the role of Pakistani scientists in proving the weak forces and the electromagnetic force are unified;	*		
		3.2.6	represent the forces acting on a body using a free-body diagram;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
3.3	Newton's Laws of Motion	3.3.1	explain Newton's laws of motion;		*	
		3.3.2	state the limitations of Newton's laws of motion;	*		
		3.3.3	identify the effect of force on velocity of a body acting in the: a. same direction, b. opposite direction, c. perpendicular direction;		*	
		3.3.4	determine the resultant of two or more forces acting along the same straight line;			A
		3.3.5	identify those objects falling in the presence of a resistive force may reach a terminal (constant) velocity;		*	
3.4	Momentum	3.4.1	define momentum with its units;	*		
		3.4.2	explain the relationship between force and momentum;		*	
		3.4.3	describe impulse with examples;		*	
		3.4.4	solve word problems related to momentum and impulse;			A
		3.4.5	state the law of conservation of momentum;	*		
		3.4.6	solve word problems using the law of conservation of momentum in one dimension;			A
		3.4.7	apply scientific and engineering ideas to design a device that minimises the force on an object during a collision (e.g., helmet or parachute);			FA[2]

[2]FA= Formative Assessment, not to be assessed under examination conditions.

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
3.5	Friction	3.5.1 3.5.2 3.5.3	define friction; differentiate between rolling friction and sliding friction; list various methods to reduce friction;	* *	 *	
3.6	Uniform Circular Motion	3.6.1 3.6.2	define centripetal force; exemplify the sources of centripetal force during circular motion in terms of: a. tension, b. frictional force, c. gravitational force.	*	*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
4. Turning Effect of Forces		Students should be able to:				
4.1	Forces on Bodies	4.1.1	define like and unlike parallel forces;	*		
		4.1.2	explain the turning effect of force by relating it to everyday life;		*	
		4.1.3	solve word problems related to the *moment of force or torque = force × perpendicular distance from the pivot to the line of action of force*;			A
4.2	Principle of Moments	4.2.1	state the principle of moments;	*		
		4.2.2	solve word problems related to the principle of moments;			A
4.3	Centre of Gravity	4.3.1	define centre of gravity and centre of mass of a body;	*		
		4.3.2	explain effects of position of the centre of gravity on the stability of simple objects;		*	
4.4	Equilibrium	4.4.1	define equilibrium;	*		
		4.4.2	classify the different types of equilibrium by using examples from everyday life;		*	
		4.4.3	state the conditions of equilibrium;	*		
		4.4.4	explain different conditions of equilibrium with examples;		*	
		4.4.5	describe the states of equilibrium and classify them with common examples.		*	

Topics and Sub-Topics		Student Learning Outcomes	Cognitive level		
			R	U	A and beyond
5. Deformation of Solids		Students should be able to:			
5.1 Hook's law	5.1.1	illustrate that force may produce a change in the size and shape of an object;			A
	5.1.2	state Hooke's law;	*		
	5.1.3	define spring constant;	*		
	5.1.4	solve word problems using the relation $k = F/x$;			A
	5.1.5	describe applications of Hook's law in measuring instruments such as spring scale, galvanometer, and balance wheel of mechanical clock;		*	
	5.1.6	interpret load extension graphs for elastic solids.			E

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
6. Work, Energy and Power		Students should be able to:				
6.1	Work	6.1.1	define work and state its SI unit;	*		
		6.1.2	solve word problems related to workdone;			A
6.2	Forms of Energy	6.2.1	define energy with its SI unit;	*		
		6.2.2	describe forms of energy stored in various objects such as gravitational potential, chemical, elastic (strain), nuclear, electrostatic and internal (thermal) energies;		*	
6.3	Kinetic Energy and Potential Energy	6.3.1	compare kinetic energy (K.E) and potential energy (P.E);		*	
		6.3.2	derive the formulae of kinetic energy $K.E = ½ mv^2$ and potential energy $P.E = mg\Delta h$;			A
		6.3.3	solve word problems related to the kinetic and potential energy;			A
6.4	Conversion of Energy	6.4.1	state law of conservation of energy;	*		
		6.4.2	describe the processes that convert energy from one form to another with reference to: a. biomass power generation b. car engines, c. geothermal power, d. hydroelectric generation, e. nuclear reactors, f. solar power panels, g. wind turbine,		*	
		6.4.3	discuss that perpetual machines do not work;			E
		6.4.4	list the environmental issues associated with power generation;	*		

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
		6.4.5	differentiate between non-renewable and renewable energy sources with examples of each;		*	
		6.4.6	describe the advantages and disadvantages of different methods of power generation;		*	
6.5	Efficiency	6.5.1	define the efficiency of a working system;	*		
		6.5.2	calculate the efficiency of an energy conversion system using the formula: *Efficiency* (%) = *energy converted into the required form / total energy input;*			A
		6.5.3	explain that a system cannot have an efficiency of 100%;		*	
6.6	Power	6.6.1	define power;	*		
		6.6.2	solve word problems related to the concept of power;			A
		6.6.3	explore different innovative energy transfer devices used in transportation and communication.			FA

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
7. Pressure		Students should be able to:				
7.1	Density	7.1.1	define the term ‘density’;	*		
		7.1.2	compare the densities of three states of matter (solids, liquids and gases);		*	
		7.1.3	solve word problems using the relation of density;			A
		7.1.4	compare the densities of different liquids to prepare a well-balanced shake/ smoothie for a restaurant;		FA	
7.2	Pressure	7.2.1	define the term ‘pressure’;	*		
		7.2.2	explain that pressure varies with force and area with the help of real-life examples;		*	
7.3	Atmospheric Pressure	7.3.1	explain atmospheric pressure;		*	
		7.3.2	describe the use of the height of a liquid column to measure the atmospheric pressure (barometer);		*	
		7.3.3	describe that atmospheric pressure decreases with the increase in height above the earth’s surface;		*	
		7.3.4	explain that changes in atmospheric pressure in a region may indicate a change in the weather;		*	
7.4	Pressure in Liquids	7.4.1	state Pascal’s law;	*		
		7.4.2	discuss the use of Pascal’s law (including hydraulic press and hydraulic brakes on vehicles);			E
		7.4.3	explain pressure beneath a liquid surface increase with depth and depends on the density of the liquid, i.e., $P = \rho gh$;		*	
		7.4.4	solve word problems related to the relationship between pressure, depth and liquid density;			A
		7.4.5	discuss the working and applications of liquid manometer.			E

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
8. Thermal Physics		Students should be able to:				
8.1	Kinetic Molecular Theory	8.1.1	state the basic assumptions of the kinetic theory of matter;	*		
		8.1.2	compare the structure of solids, liquids and gases based on the kinetic theory of matter;		*	
		8.1.3	describe plasma as the fourth state of matter;		*	
		8.1.4	state the relationship between the motion of particles and temperature;	*		
		8.1.5	discuss that an increase in the temperature of an object increases its internal energy;			E
8.2	Thermal Properties of Matter	8.2.1	describe the thermal expansion of solids in terms of: a. linear expansion, b. volumetric expansion;		*	
		8.2.2	explain the thermal expansion of liquids as the: a. real expansion, b. apparent expansion;		*	
		8.2.3	define the terms 'heat capacity' and 'specific heat capacity';	*		
		8.2.4	describe latent heat of fusion and latent heat of vaporisation;		*	
		8.2.5	describe melting, solidification, boiling and condensation in terms of energy transfer without the change in temperature;		*	
		8.2.6	determine heat of fusion and heat of vaporisation of ice and water respectively by sketching a temperature-time graph;			A
		8.2.7	solve word problems involving the concept of specific heat capacity, latent heat of fusion and vaporisation;			A
		8.2.8	describe the process of evaporation and how it is different from boiling;		*	
		8.2.9	explain that evaporation causes cooling;		*	
		8.2.10	describe factors that influence the rate of surface evaporation;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
8.3	Temperature Scale and Thermometer	8.3.1	describe the Celsius, Fahrenheit, and Kelvin temperature scales and their relationships using fixed reference points;		*	
		8.3.2	convert temperature from one scale to another (Fahrenheit, Celsius and Kelvin scales);			A
		8.3.3	explain that a physical property that varies with temperature can be used as a criteria to measure temperature;		*	
		8.3.4	illustrate the sensitivity, range and linearity of thermometers using diagram;			A
		8.3.5	compare liquid in glass thermometer and thermo-couple on the bases of structure, sensitivity, range and linearity.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
9. Transfer of Thermal Energy		Students should be able to:				
9.1	Conduction	9.1.1	explain thermal conduction in solids;		*	
		9.1.2	define the term 'thermal conductivity';	*		
		9.1.3	describe the factors affecting the transfer of heat through solid conductors;		*	
		9.1.4	solve word problems related to the thermal conductivity of solid conductors;			A
		9.1.5	describe good and bad conductors of heat with examples;		*	
		9.1.6	list the uses of good and bad conductors;	*		
9.2	Convection	9.2.1	explain convection in liquids and gases in terms of density changes with reference to the following real-life examples: a. gliders, b. flying of birds, c. land breezes and sea breezes;		*	
		9.2.2	design a thought experiment to illustrate convection;			FA
		9.2.3	describe that convection currents in seawater facilitate the distribution of heat, nutrients, and oxygen in supporting marine ecosystems;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
9.3	Radiation	9.3.1	define the process of thermal energy transfer by radiation;	*		
		9.3.2	describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of infrared radiation;		*	
		9.3.3	describe that the rate of emission of radiation depends on the surface temperature and surface area of an object;		*	
		9.3.4	design experiments to distinguish between good and bad emitters of infrared radiation;			FA
9.4	Effects of Heat Transfer	9.4.1	discuss everyday applications of conduction, convection and radiation including: a. heating objects such as kitchen pans, b. heating of room by convection, c. measuring temperature using an infrared thermometer, d. using thermal insulation to maintain the temperature of a liquid and to reduce thermal energy transfer in buildings, e. the mechanism of a household hot-water system;			E
		9.4.2	describe the greenhouse effect based on heat radiation emitted by the sun;		*	
		9.4.3	explore the impacts of heat transfer and conservation on people's bedding and clothing in various climatic regions of South Asia.			FA

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
10. Nature of Science		Students should be able to:				
10.1	Physics and its Interaction	10.1.1	describe Physics as the study of matter, energy, space, time and their interactions;		*	
10.2	Sub-Fields of Physics	10.2.1 10.2.2	mention Physics as a subset of physical and natural science; relate different branches of physics with real-life examples;	* 	 *	
10.3	Scientific Approach/ Method	10.3.1	define different scientific methods (hypothesis, theory and law) for carrying out investigations;	*		
10.4	Science, Technology and Engineering	10.4.1	describe the importance of Physics in science, technology and engineering.		*	

Topic Wise Practical Activities

Part I (Grade IX)

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 1: Measurement	
1	To find the weight of an unknown object using vector addition of forces.	Gravesand's apparatus, slotted weights with hangers, plane mirror strips, plumb line, thread.
2	To calculate the area of the cross-section of a solid cylinder by measuring the diameter with Vernier callipers.	Vernier callipers, solid cylinder.
3	To measure the thickness of a metal strip or the diameter of a wire using a screw gauge.	Screw gauge, wire or metal strip.
	Topic 2: Kinematics	
4	To find the acceleration of a ball rolling down an angle-iron by drawing a graph between distance (2S) and time (t^2).	Angle iron, iron ball, iron stand, stopwatch, set square.
5	To find the value of acceleration due to gravity "g" using the free-fall method.	Free fall apparatus, pendulum bob, thread, candle, piece of chalk, plumb line.

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 3: Dynamics	
6	To find the tension in strings by balancing a meter rod on the iron stands.	Two iron stands, two spring balances, meter rod, wedge, slotted weight with hangers, thread.
	Topic 4: Turning Effect of Forces	
7	To find the weight of an unknown object using the principle of moments.	Meter rod, weight box, thread, wooden wedge.
8	To verify the principle of moments using a meter rod balanced on a wedge.	Meter rod, weight box, thread, wooden wedge.
	Topic 5: Deformation of Solids	
9	To study the relationship between load and extension of a helical spring with the help of a graph.	Helical spring with stand, pan, weight box, meter rod.
	Topic 7: Pressure	
10	To find the density of an insoluble object that is heavier than water using Archimedes principle.	Physical/ digital balance, weight box, beaker, thread, small wooden bench, thermometer, water.
	Topic 8: Thermal Physics	
11	To draw a graph between temperature (ºC) against time (minutes) for the conversion of ice into water and then steam as a result of slow heating.	Thermometer, beaker, spirit lamp, sand, ice, stopwatch, burner.
12	To find the specific heat by the method of mixture using polystyrene cups. (used as a container of negligible heat capacity).	Polystyrene cup with lid and stirrer, hypsometer, burner, thermometer, Physical/ digital balance, weight box, water.

Scheme of Assessment

Grade IX

Table 1: Exam Specifications

Topic No.	Topics	Marks Distribution			Total Marks
		MCQs	CRQs	ERQs	
1	Measurements	3	Total 3 Marks (1 CRQ)		6
2	Kinematics	6		5 Marks Choose any ONE from TWO	11
3	Dynamics	8			13
4	Turning Effect of Forces	2	Total 3 Marks (1 CRQ)		5
5	Deformation of Solids	1	Total 3 Marks (1 CRQ)		4
6	Work, Energy and Power	6		5 Marks Choose any ONE from TWO	11
8	Thermal Physics	6			11
7	Pressure	4	Total 3 Marks (1 CRQ)		7
9	Transfer of Thermal Energy	2	Total 3 Marks (1 CRQ)		5
10	Nature of Science	2			2
	Total	**MCQ 40**	**CRQ 15**	**ERQ 10**	**65**
	Practical*				**10**
	Total				**75**

Examination Structure and Practical Requirements for Grades IX and X

Theory:

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.
- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.
- Extended Response Question (ERQ) requires students to answer in a more descriptive form. The answer should be in paragraph form, with diagrams where needed, and address all parts of the question.
- Table 1 to 2 contains the mark distribution for each topic.
- There will be two examinations, one at the end of grade IX and one at the end of grade X.
- In each grade, the theory paper will be of 3 hours and will consist of two parts: paper I and paper II.
- Paper I theory will consist of 40 compulsory, multiple choice items. These questions will involve four responses options. The answer sheet for paper I will be provided separately.
- Paper II theory will carry 25 marks and consist of Constructed Response Questions (CRQs) and Extended Response Questions (ERQs). Each extended response question will be presented in an either/ or form.
- The booklet for paper II will serve as an answer script.

Practical:

- In each grade, practical examination (Paper III) will be conducted separate from the theory paper and will consist of 10 marks.
- Practical examination (Paper III) will be based on the list of practical activities given in the examination syllabus. Schools may design their own practical manuals based on these activities for teaching and learning purpose.
- Practical journal/ portfolio should be developed by students and endorsed by a figure of authority, such as a teacher or principal, and submitted at the time of the practical examination (Paper III).
- It is essential for each school to equip its laboratories with chemicals, instruments, apparatus, specimens etc. according to the requirements of the practical activities. Each school will be responsible to make sure that each student is provided the opportunity to do the practical activities.