

नेपाल सरकार
शिक्षक सेवा आयोग
माध्यमिक शिक्षकको अध्यापन अनुमतिपत्रको लिखित परीक्षा पाठ्यक्रम, २०७५

(क) पहिलो पत्र : विज्ञान

- ६५ अङ्क

परिचय

यस पत्रले विषयवस्तुको ज्ञान, शिक्षण तौरतरिका र शिक्षण सहजीकरणमा सूचना तथा सञ्चार प्रविधिको प्रयोगसम्बन्धी सिपलाई समेटेको छ । यस पत्रको अङ्कभार ६५ कायम गरिएको छ । यस पत्रको परीक्षणको लागि पाठ्यक्रममा राखिएको सम्बन्धित विषय क्षेत्रको पाठ्यवस्तु परीक्षण गर्न १ अङ्क भारका दरले ४० ओटा वस्तुगत (बहुवैकल्पिक) प्रश्न र शिक्षण सिकाइका तौरतरिका (विधि), सिकाइमा सूचना तथा सञ्चार प्रविधिको प्रयोगसम्बन्धी ज्ञान परीक्षण गर्नका लागि ५ अङ्क भारका दरले ५ ओटा प्रश्नहरू सोधिने छन् । यस अन्तर्गत शिक्षकले प्रदर्शन गर्नुपर्ने विज्ञान विषय क्षेत्रका सक्षमताहरूलाई समावेश गरिएको छ ।

उद्देश्य

यस पत्रको उद्देश्य शिक्षण पेसामा प्रवेश गर्न इच्छुक व्यक्तिहरूमा रहेको विषयवस्तु सम्बन्धी ज्ञान, शिक्षण सहजीकरणका तौर तरिका, शिक्षण विधि, मूल्याङ्कन र सूचना तथा सञ्चार प्रविधिको प्रयोग लगायतका विषयवस्तुको ज्ञान, सिप र शिक्षण कौशलताको परीक्षण गर्ने रहेको छ ।

खण्ड (क) : विषयवस्तुसम्बन्धी ज्ञान

-४० अङ्क

1. Physics

1.1 Mechanics

- 1.1.1 Unit and measurement: Need for measurement, SI Units, Fundamental and derived units,
- 1.1.2 Scalar and vector quantities, parallelogram, addition and subtraction of vectors,
- 1.1.3 Simple machine: Introduction, Mechanical advantage, efficiency and velocity ratio, law of moment, moment of force, torque
- 1.1.4 Force : Newton's law of motion, inertia, conservation of linear momentum, application of Newton's law of motion, Newton's law of gravitation, acceleration due to gravity, mass and weight, variation of value of "g", free fall and weightlessness, motion of satellites, escape velocity
- 1.1.5 Work , energy and power: work done by constant and variable force, kinetic energy, potential energy, work energy theorem, conservation of energy, relationship between work, energy and power,
- 1.1.6 Fluid mechanics and dynamics : Pressure in a fluid, Law of flotation, Archimedes Principle, Application of atmospheric pressure, Surface tension, Newton's law of viscosity, Stokes law and its application, Bernoulli's equation and its application
- 1.1.7 Introduction of Rotational dynamics, Hook's law, and simple harmonic motion

1.2 Heat and Thermodynamics

- 1.2.1 Heat and temperature,
- 1.2.2 Measurement of temperature, thermometry,
- 1.2.3 Thermal expansion, liquid expansion
- 1.2.4 Heat capacity and Specific heat capacity, Newton's law of cooling, changes of phases, latent heat
- 1.2.5 Transfer of heat : conduction, convection and radiation
- 1.2.6 Thermal properties of matter: Equation of state, ideal gas equation, molecular properties of matter, kinetic energy of gas molecule
- 1.2.7 Saturated and unsaturated vapor pressure, absolute humidity, relative humidity and its determination
- 1.2.8 Introduction of first law and second law of thermodynamics and its application

1.3 Optics

- 1.3.1 Reflection at curve mirror, concave and convex mirror, mirror formula, real and virtual images

- 1.3.2 Refraction through prism: minimum deviation, relationship between angle of prism, minimum deviation and refractive index
- 1.3.3 Introduction of lens, lens maker formula, power of lens
- 1.3.4 Optical instruments : Human eye, defect of vision and its correction, camera, microscope, telescope and binocular
- 1.3.5 Nature and propagation of light, electromagnetic spectrum, Huygen's principle, velocity of light,
- 1.3.6 Phenomena of interference, coherent sources, Newton's ring
- 1.3.7 Concept of diffraction and polarization of light
- 1.3.8 Defects of vision and their correction
- 1.3.9 Phenomenon diffraction and polarization of light
- 1.3.10 Introduction of X rays and ultra sound and its application

1.4 Electrostatics

- 1.4.1 Electric charge, conductors and insulators, Coulomb's law,
- 1.4.2 Electric field, Gauss law and its application, electric flux,
- 1.4.3 Potential and potential difference, Potential due to a point charge, potential energy, electron volt
- 1.4.4 Capacitance and capacitor, charging and discharging of capacitor, combination of capacitors, effect of dielectric, molecular theory of induced charges
- 1.4.5 **Waves**
- 1.4.6 Free, damped and forced oscillation,
- 1.4.7 Longitudinal and Transverse motion of waves, progressive and stationary waves
- 1.4.8 Reflection and refraction of sound waves
- 1.4.9 Velocity of sound in solid, liquid and gas, Effect of temperature, pressure and humidity on velocity of sound
- 1.4.10 Characteristics of sound: Intensity, loudness, pitch, quality, Doppler effect,
- 1.4.11 Concept of in wave and strings, law of vibration of fixed string
- 1.4.12 Principle of superposition; Resonance; Sonometer
- 1.4.13 Infrasonic and ultrasonic waves,

1.5 Current Electricity

- 1.5.1 Electric circuit
- 1.5.2 Ohm's law,
- 1.5.3 Electrical resistance, resistivity and conductivity,
- 1.5.4 Current - voltage relations,
- 1.5.5 Ohmic and non Ohmic resistance , Resistance in series and parallel
- 1.5.6 Consumption of electricity
- 1.5.7 Electromotive force and potential difference
- 1.5.8 Joule's law and its verification
- 1.5.9 Electrical circuits- Kirchhoff's laws, Wheastone bridge circuit
- 1.5.10 P.O. box, meter bridge and potentiometer
- 1.5.11 Faraday's laws of electrolysis, verification of Faraday's law of electrolysis

1.6 Magnetic field of current

- 1.6.1 Molecular theory of magnetism
- 1.6.2 Methods of preparation of magnets
- 1.6.3 Magnetic field and magnetic lines of forces
- 1.6.4 Dip and dip circle
- 1.6.5 Relative permeability, susceptibility, hysteresis,
- 1.6.6 Dia-, Para- and Ferro-magnetic materials
- 1.6.7 Faraday's law of electromagnetic induction,
- 1.6.8 Lenz's law, eddy current
- 1.6.9 Generator, Dynamo and transformer
- 1.6.10 Introduction of alternative current, peak and RMS value of AC current and voltage

1.6.11 Solar battery, battery charger, invertors, adopter

1.7 Modern physics

1.7.1 Milikan's oil drop experiments. Cathode rays, motion of electron in electric and magnetic field,

1.7.2 Quantum nature of radiation, Einstein photo electric effect

1.7.3 Introduction of solids and semiconductor devices

1.7.4 Quantization of energy - Bohr's theory of hydrogen atom, Uncertainty principle

1.7.5 Nature, production, properties and uses of laser,

1.7.6 Nature, production, and uses of X- rays, Bragg's law

1.7.7 Radioactivity: Alfa particles, Beta particles, Gama rays, law radioactive disintegration, half-life and decay constant,

1.7.8 Nuclear energy : Energy released from fission and fission, thermal and hydroelectric power, wind energy, Biofuels, solar energy

1.7.9 Particle physics and cosmology : Particle and antiparticles, Quarks, leptons, baryons and mesons

2. Chemistry

2.1 Atomic structure

2.1.1 Classification of elements: Mendeleev's periodictable, and modern periodic table, division of elements into s,p,d and f blocks, electronic configuration, molecular formula,

2.1.2 Fundamental particles of atoms

2.1.3 Rurherford's and Bohr's model of atom

2.1.4 Pauli's exclusion principle

2.1.5 Aufbau principle

2.1.6 Basic assumptions of electronic theory of valency

2.1.7 Octet rule

2.1.8 Chemical bonding: Covalent and coordinate covalent bonds

2.2 Chemical Reaction

2.2.1 Chemical equations and types,

2.2.2 Role of catalyst in chemical reaction

2.2.3 Concept and electronic interpretation of oxidation and reduction

2.2.4 Difference between oxidation number and valency

2.2.5 Redox reaction

2.2.6 Concept and influencing factors of reaction rate

2.2.7 Rate law of equation

2.2.8 Half-life of a reaction

2.2.9 Concept of a activation energy

2.3 State of matter

2.3.1 Gas law : Boyle's law, Charle's law, Dalton's law

2.3.2 Kinetic model of gas, Ideal and real gas

2.3.3 Physical properties of liquid: Evaporation, condensation, vapor pressure

2.3.4 Solution and Solubility: Saturated, unsaturated and supersaturated solution, equilibrium in saturated solution, solubility cure and its application

2.3.5 Crystalline and amorphous of solids, water crystallization, seven types of crystal system

2.4 Acid, base and salts

2.4.1 Properties and use of acid base and salts

2.4.2 Ionization of weak electrolyte, degree of ionization,

2.4.3 Lewis concept of acids and base

2.4.4 Ionization of water, pH and pH scale

2.4.5 Hydrolysis of salts

2.4.6 Application of neutralization in daily life

2.5 Electro chemistry

- 2.5.1 Electrolysis, strong and weak electrolyte
- 2.5.2 Arrhenius theory of ionization,
- 2.5.3 Faraday's law of electrolysis
- 2.5.4 Electrolytic conduction
- 2.5.5 Variation of conductivity with concentration

2.6 Non-metals

- 2.6.1 Preparation, properties and uses of oxygen, hydrogen, nitrogen, ammonia and carbon dioxide
- 2.6.2 Water: structure, solvent properties of water, heavy water, use of water
- 2.6.3 Preparation, properties and uses of halogens (Chlorine, Bromine and Iodine)
- 2.6.4 Preparation, properties uses of carbon monoxide, phosphine, and sulphur dioxide
- 2.6.5 Position in periodic table and uses of Nobel gas
- 2.6.6 Environmental pollution: Air pollution, acid rain, water pollution, greenhouse effect

2.7 Metals

- 2.7.1 General properties of matter, difference between metal and non-metals,
- 2.7.2 Preparation, properties and uses of aluminum, silver copper, iron and gold
- 2.7.3 Preparation, properties and uses of quick lime, plaster of Paris, Bleaching power and Epsom salt
- 2.7.4 Importance of mineral deposit in Nepal

2.8 Carbons and its compounds

- 2.8.1 Properties of carbon, organic and inorganic compounds,
- 2.8.2 Classification of organic compounds,
- 2.8.3 Functional group of homologues series
- 2.8.4 IUPAC rules of naming of hydrocarbons
- 2.8.5 Preparation, properties and uses of alkanes, alkenes and alkynes
- 2.8.6 Preparation, properties and uses of methane, benzene, alcohol, phenol and ethers

2.9 Chemicals uses in daily life

- 2.9.1 Chemical fertilizers: Types and uses of nitrogenous, phosphate and potassic fertilizers
- 2.9.2 Preparation and uses of compost fertilizers
- 2.9.3 Some chemicals uses in daily life : Cement, glass, fiber, ceramics, soap, detergents, pesticides (insecticides, herbicides, weedicides and fungicides)
- 2.9.4 Polymer: natural and synthetic polymers, preparation of polymer, Polyvinyl Chloride (PVC), Nylon – 66, use of Bakelite

3. Biology

3.1 Introduction to biology

- 3.1.1 Nature and scope of biology
- 3.1.2 Branches and of biology with other sciences
- 3.1.3 Importance of organic and inorganic molecules: carbohydrates, protein, lipid, nucleic, acid, minerals and water

3.2 Cell biology

- 3.2.1 Cell as a unit of life, structure and function of cell organelles and inclusions
- 3.2.2 Mitosis and meiosis cell division

3.3 Biodiversity

- 3.3.1 Meaning and scope of biodiversity, flora and faunal diversity in Nepal
- 3.3.2 Characteristics and protozoa phylum, structure and reproduction of paramecium,
- 3.3.3 General characteristics and classification of Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, and Chordata,
- 3.3.4 Earthworm : Habit and habitat, digestive and reproductive system, economic importance
- 3.3.5 Frog : Habit and habitat, digestive and reproductive system, economic importance
- 3.3.6 Life cycle of silkworm, honey bees, muscivores
- 3.3.7 Structure and reproduction of Mucor, Yeast, Spirogyra

- 3.3.8 Life cycle of Marchantia, Funaria, and Dryopteris
- 3.3.9 Morphological structure of Cycas and Pinus
- 3.3.10 Angiosperm : Morphology, root, stem, flower, fruit, and seed
- 3.3.11 Structure and economic importance of bacteria, virus and fungi

3.4 Biota and their environment

- 3.4.1 Ecology: Introduction, abiotic and biotic factors and their interactions
- 3.4.2 Ecosystem : pond, grassland, mountain,
- 3.4.3 Food chain, ecological pyramid, productivity,
- 3.4.4 Adaptation : animal, amphibians, terrestrial
- 3.4.5 Biochemical cycle: carbon and nitrogen cycle
- 3.4.6 Wildlife conservation : meaning, importance, vulnerable and endangered species in Nepal, conservation practices(National parks, wild life reserve and hunting services)
- 3.4.7 Introduction of forest in Nepal, importance of a forestation and hazards of deforestation

3.5 Anatomy and physiology of organism

- 3.5.1 Plant anatomy : Types of tissues, meristematic and permanent tissue, internal structure of monocot and dicot root, stem and leaf
- 3.5.2 Plant physiology : Water relation, photosynthesis, respiration, growth, plant movement
- 3.5.3 Animal tissues : Connective , muscular and nervous

3.6 Human biology

- 3.6.1 Nutrition: digestive organs and digestion of food
- 3.6.2 Respiratory organs and mechanism
- 3.6.3 Blood circulation : structure and function of blood, heart and its function, blood groups, blood sugar blood pressure , uric acid
- 3.6.4 Excretion : Excretory organs, mechanism of urine formation, temperature regulation, kidney and liver control system
- 3.6.5 Nerves system : types of nerves system, structure and function of brain, transmission of nerve impulse
- 3.6.6 Endocrinology: structure, function of pituitary, thyroid, pancreas,
- 3.6.7 Structure and function of eye and ear
- 3.6.8 Reproductive organs
- 3.6.9 Structure and function of skeleton system, classification of bones

3.7 Developmental biology

- 3.7.1 Reproduction and development of angiosperms : asexual reproduction, pollination, development of male and female gametophyte, fertilization and development of embryo in monocot and dicot
- 3.7.2 Sexual reproduction in animal : frog, fish, earthworm
- 3.7.3 Gametogenesis in animals
- 3.7.4 Chromosomes and sex determination

3.8 Origin and Evolution of life

- 3.8.1 Origin of life
- 3.8.2 Theory of origin of life
- 3.8.3 Meaning of evolution, organic evolution
- 3.8.4 Evidences of evolutions
- 3.8.5 Lamarckism, Darwinism and Neo Darwinism
- 3.8.6 Human evolution
- 3.8.7 Structures of plant and animal cell

3.9 Genetics

- 3.9.1 Elements of heredity and variation, Genetic material (DNA and RNA),
- 3.9.2 Genetic code, Gene pool, Genetic expression and its regulation
- 3.9.3 Mendel's law of inheritance,

3.9.4 Concept of incomplete dominance and co-dominance,

3.9.5 Multiple gene, linkages, crossing over, Mutation,

3.10 Application of biology

3.10.1 Grafting, layering and tissue culture

3.10.2 Introduction to biotechnology, tissue culture, concept of breeding

3.10.3 Genetic engineering and its application

3.10.4 Application of fermentation technology

3.10.5 Antibiotics vaccines,

3.10.6 Tissue and organ transplantation,

3.10.7 Test tube baby

3.10.8 Poultry farming and fish farming

4. Geology and Astronomy

4.1 Geology

4.1.1 History of the earth

4.1.2 Structure of the earth

4.1.3 Green House Effect,

4.1.4 Ozone layer and its importance, depletion of ozone layer

4.1.5 Climate change

4.1.6 Atmospheric layers

4.1.7 Natural disasters (Earthquake, lands slides, floods, snow fall, hurricane)

4.1.8 Environment pollution(acid rain, air, noise, water, soil, fuels deforestation)and management

4.2 Astronomy

4.2.1 Solar system

4.2.2 Galaxies

4.2.3 Rotation of the earth

4.2.4 Phases of moon

4.2.5 Lunar and solar eclipses

4.2.6 Comets, meteors and meteorites

4.2.7 Constellations

4.2.8 Zodiac Constellation

4.2.9 Identification of stars and constellations

4.2.10 Natural and artificial satellites`

4.2.11 Universe : Hubble law, Big Bang, Critical density, Dark matter

4.2.12 Black hole

खण्ड (ख) : शिक्षण सहजीकरण प्रक्रिया

- २५ अङ्क

५. विज्ञान शिक्षणको अवधारणा

५.१ वैज्ञानिक जाँच: अवलोकन, कारण (reasoning) र प्रयोग

५.२ वैज्ञानिक ज्ञानको प्रकृति: हाइपोथेसिस, पोस्चुलेट (poatulate), सिद्धान्त र नियम

५.३ वैज्ञानिक विधि : अवधारण र प्रक्रिया

५.४ वैज्ञानिक अभिवृद्धि (attitude): अवधारणा र विकास

५.५ विज्ञान शिक्षणको अवधारणा र महत्व

५.६ विज्ञान, वैज्ञानिक गतिविधि र सामाजिक जीवन पद्धती

५.७ वैज्ञानिक तथा प्राविधिक साक्षरता (Scientific and technological literacy -STL) को अवधारणा र अभ्यास

५.८ विज्ञानका प्रवर्तनात्मक कार्यक्रमहरू (Science popularizing activities): ओलम्पियाड, विज्ञान फेयर, विज्ञान क्विज, विज्ञान फोरम, विज्ञान कर्नर, विज्ञान क्लब, विज्ञान प्रदर्शनी

६. शैक्षणिक योजना

६.१ नेपालमा विज्ञानको विषयको पाठ्यक्रम निर्माण, सुधार र प्रयोग

- ६.२ माध्यमिक तहको पाठ्यक्रम निर्माणको अन्तर्राष्ट्रिय अभ्याश र नमुना पाठ्यक्रमको अध्ययन (भारत, फिलिपिन्स, सिंहापुर, मलेसिया, अमेरिका, बेलायत र क्यानडा)
- ६.३ ब्लुम्स टेक्सोनोमी, परिमार्जित ब्लुम्स टेक्सोनोमी: परिचय, महत्व र प्रयोग
- ६.४ वार्षिक, एकाइ, दैनिक पाठयोजना निर्माण र प्रयोग
- ६.५ पाठ्यक्रम कार्यान्वयन कार्ययोजना (Curriculum implementation guidelines)
- ६.६ शिक्षण सुधार योजना (Teaching Improvement Plan-TIP)

७. शिक्षण सहजीकरण

- ७.१ शिक्षण सिकाइमा पाठ्यक्रम, पाठ्यपुस्तक, शिक्षक निर्देशिका र सन्दर्भ सामग्रीको प्रयोग
- ७.२ विज्ञान शिक्षणका शैक्षणिक आधारहरू: निर्माणवाद, जीनपियाजे, ब्रुनर, हिल्डाटावा, (Inductive Thinking), सुचमान (Suchman's Inquiry model) का अवधारणहरूको शिक्षणमा प्रयोग
- ७.३ विज्ञान शिक्षणका आधारभूत शिक्षण विधिहरू: छलफल, प्रदर्शन, प्रश्नोत्तर, स्थलगत अध्ययन, प्रयोगात्मक कार्य, अवलोकन, लघु परियोजना, अन्वेषण, समस्या समाधान, भूमिका अभिनय, खोज विधि, सेटालाइट विधि ।
- ७.४ विज्ञान शिक्षणका बैकल्पिक शिक्षण विधि: भान्साकोठे, रैथाने, सूचना प्रविधिमा आधारितमा शिक्षण
- ७.५ विज्ञानका प्रक्रियागत सिपहरू (science process skills): अवलोकन (observing), सञ्चार (communicating), वर्गीकरण (classifying), मापन (measuring), अनुमान (inferring), भविष्यवाणी (predicting), मोडेल बनाउने (makingmodel), परिभाषित गर्ने (define operationally) र अन्वेषण (investigating), अनुमान, अवलोकन र व्याख्या (predict, observe and explain)
- ७.६ विज्ञान शिक्षणमा सूचना प्रविधिको प्रयोग: Web 2.0 tools(Virtual Lab, PhET, Open learn, Google Sky, NSDL Teacher Domain, Khan Academy, Science experiments etc.), Social media, You tube, power point presentation,
- ७.७ अनुसन्धानमा आधारित शिक्षण: कार्यमूलक अनुसन्धान, परियोजना कार्य, मामला अध्ययनको विज्ञानमा शिक्षणमा प्रयोग
- ७.८ शैक्षणिक स्रोत सामग्री: प्रयोगशालामा आधारित सामग्रीको प्रयोग, स्थानीय स्रोत साधनमा आधारित शिक्षण सामग्री संकलन, निर्माण र प्रयोग
- ७.९ प्रयोगात्मक कार्य: प्रयोगशालामा आधारित र स्थानीय स्रोत सामग्रीमा आधारित प्रयोगात्मक कार्यहरू, प्रयोगात्मक कार्यका आधारहरू, प्रयोगशाला कार्यको सुरक्षा र सावधानी,

८. मूल्याङ्कन प्रक्रिया

- ८.१ लिखित र प्रयोगात्मक परीक्षा सञ्चालनका तरिका
- ८.२ विशिष्टकरण तालिका,
- ८.३ प्रश्नपत्र र उत्तर कुञ्जिका निर्माण,
- ८.४ प्रश्नपत्र विश्लेषण (SEE, कक्षा ११ र कक्षा १२ का प्रश्नपत्रहरू)
- ८.५ मूल्याङ्कनमा रुब्रिक्सको प्रयोग
- ८.६ पोर्टफोलियो व्यवस्थापन

प्रश्ननिर्माण योजना (Specification Grid)

क्र. सं.	प्रश्न एकाई	वस्तुगत (बहुवैकल्पिक) प्रश्न			विषयगत प्रश्न			जम्मा प्रश्न सङ्ख्या	पूर्णाङ्क
		प्रश्न संख्या	अङ्क भार	जम्मा	प्रश्न संख्या	अङ्क भार	जम्मा		
१	भौतिक विज्ञान	१२	१	१२	-	-	-	१२	१२
२	रसायन विज्ञान	११	१	११	-	-	-	११	११
३	जीव विज्ञान	११	१	११	-	-	-	११	११
४	भू तथा अन्तरिक्ष विज्ञान	६	१	६	-	-	-	६	६
५	विज्ञान शिक्षणको अवधारणा	-	-	-	१	५	५	१	५
६	शैक्षणिक योजना	-	-	-	१	५	५	१	५
७	शिक्षण सहजिकरण	-	-	-	२	५	१०	२	१०
८	मूल्याङ्कन प्रक्रिया	-	-	-	१	५	५	१	५
	जम्मा	४०	१	४०	५	५	२५	४५	६५

द्रष्टव्य :

१. प्रश्नपत्र तयार गर्दा संज्ञानात्मक तहका सबैजसो क्षेत्र समेटिने छन् ।
२. विषयगत प्रश्नहरू मार्फत सिर्जनशीलता र शिक्षणसँग सम्बन्धित व्यावहारिक पक्षहरू मापनगर्ने उद्देश्य राखिने छ ।
३. कण्ठस्थ गरी दिइएका जवाफभन्दा शिक्षण सिकाइसँग सम्बन्धित व्यावहारिक पक्षहरूको विश्लेषण/विवेचनातथा समस्याको समाधान गर्दै दिइएका मौलिक तथा सिर्जनात्मक उत्तरलाई प्रोत्साहित गरिने छ ।
४. खण्ड (ख) अन्तर्गतका शिक्षणकलासँग सम्बन्धित प्रश्नहरू खण्ड (क) मा दिइएका विषयहरूको व्यावहारिक पक्षसँग जोडेर तयार गरिने छन् ।
५. लामो उत्तर आउने प्रश्नहरू शिक्षणमा सूचना प्रविधिको प्रयोगलाई समेत ध्यान दिइने छ ।