

नेपाल सरकार  
शिक्षक सेवाआयोग  
माध्यमिक तह (कक्षा ९-१२) को शिक्षक अध्यापन अनुमतिपत्रको लिखित परीक्षा पाठ्यक्रम, २०७५

पहिलो पत्र : गणित  
परिचय

- ६५ अङ्क

गणित विषयको यस पत्रले माध्यमिक तहको (कक्षा ९-१२) गणित अध्ययनको विषयगत ज्ञान, सिप, शिक्षण सहजीकरणका तौरतरिका, शैक्षणिक योजना निर्माण र शिक्षण सहजीकरणमा सूचनातथा सञ्चार प्रविधिको प्रयोगसम्बन्धी विशिष्टकृत सिपलाई समेटेको छ। यसका साथै गणित विषयसँग अन्तरसम्बन्धित विषयहरूसँगको सम्बन्ध जस्ता विषयहरू समेटिएका छन्। यस पत्रको अङ्कभार ६५ कायम गरिएको छ।

उद्देश्य

यस पत्रको उद्देश्य शिक्षण पेसामाप्रवेश गर्न चाहने र खास गरी गणित शिक्षण गर्न चाहने व्यक्तिहरूमा रहेको विषयवस्तुको ज्ञान, सिप, शिक्षण तौरतरिका, मूल्याङ्कन र शिक्षण सहजीकरणमा आवश्यक ज्ञान, सिप, प्रवृत्ति र परिस्थिति अनुकूल निर्णय गर्न सक्ने र माध्यमिक तहको गणित विषय शिक्षणमा आवश्यक क्षमताको परीक्षण गर्ने रहेको छ।

खण्ड (क) : गणित विषयको विषयवस्तुसम्बन्धी ज्ञान

- ४० अङ्क

1. Set and Number System: Set, Real and Complex Number System and their properties.
  - 1.1 Set and Notations, relation between sets, operations on set, algebra of sets, denumerable sets and its cardinality, open and closed set/intervals
  - 1.2 Real Number system: Properties of real number, order axiom, absolute value of real number, Boundedness property, supremum and infimum of a subset of real numbers, completeness axiom.
  - 1.3 Complex number system: Imaginary unit, complex numbers and its geometrical interpretation, conjugate of complex number, absolute value of complex number, square root of complex number, polar form of a complex number.
2. Calculus: Function, Limit, continuity, Derivative, Anti-Derivative, Curve Sketching.
  - 2.1 Concept of function, Meaning of  $x \rightarrow a$ , limit of an algebraic function, infinity as a limit of a function, limit of trigonometric function, limit of logarithmic and exponential and absolute value function
  - 2.2 Left hand and right-hand limit, Concept of continuities and discontinuities of a function, type of discontinuity (ordinary, removable and infinite)
  - 2.3 Relationship between continuity and differentiability of a function, Definition of tangent as the limit of secant line, derivative of function and its geometrical meaning, basic techniques of differentiation (sum rule, product rule, power rule, quotient rule, chain rule), differentiating algebraic, trigonometric, logarithm and exponential function, increasing and decreasing function, maximum and minimum value of a function in an interval.
  - 2.4 Concept of antiderivatives, Technique of integration, integration of basic algebraic and trigonometric function, area as a definite integral
  - 2.5 Even function, odd function, symmetricity of the function, increasing and decreasing function, periodicity of the function, Characteristics (and curve sketching) of linear, parabolic, hyperbolic, circular, asymptotic, cubic, trigonometric and logarithmic function)
3. Discrete Mathematics (Logic, permutation and combination, Mathematical induction, Number Theory, Graph Theory)
  - 3.1 Statements, logical connectives, conditional and bi-conditional statements, truth table, tautology and contradiction, arguments, Euler diagram
  - 3.2 Basic principle of counting, arrangement of objects indifferent cases (all different, not all different, circular), selection of objects (combination) and its properties
  - 3.3 Concept of mathematical induction, mathematical induction as a method of proof, its general process
  - 3.4 Fundamental concepts in number theory (well ordering principle, order axiom, trichotomy law, prime and composite. etc.), Divisibility theory and its properties, GCD and its properties, relatively prime numbers, fundamental theorem of arithmetic, concept of linear Diophantine equation, congruence modulo and its properties, the divisibility test,

- 3.5 Basic concepts (vertex, edge, graph, degree of vertex, parallel edges, loop, simple graph, empty and null graph, adjacent vertices, pendant vertex and edge, isolated vertex, multi-graph), relation between vertex and edge in a graph, complete graph, concept of walk, path, trail, cycle, dis/connected graph, concept of subgraph, the Königsberg Bridge problem,
- 3.6 Eulerian circuit and Eulerian trail, Hamiltonian circuit
- 3.7 Concept of tress and basic properties, concept of diagraph
- 4. Statistics (Central Tendency, Dispersion, Correlation and Regression, Skewness)
  - 4.1 Concept and appropriate use of measure of central tendencies (mean, median, mode) and quartile values.
  - 4.2 Concept and appropriate use of measure of dispersion (range, QD, MD, SD) and coefficient of variation
  - 4.3 Correlation and regression analysis
  - 4.4 Use of skewness
- 5. Analysis (Axiomatic Foundation of Real Number, Real Sequence, Infinite Series and infinite product, Riemann integral – integration by parts)
  - 5.1 Axiomatic Foundation of Real Number
  - 5.2 Sequence, boundedness of sequences, upper and lower limit points of bounded sequences, Non/convergent sequences, monotonic sequences
  - 5.3 Meaning of infinite series, convergent series, different test of convergence series, series of positive and negative terms, product of infinite series
- 6. Geometry (Axiomatic System, Euclidian Geometry, Analytical Geometry – Plan, Conic Section, Sphere)
  - 6.1 Axiomatic system and their properties (Fe's and Fo's)
  - 6.2 Euclidian geometry
  - 6.3 Analytical geometry
    - 6.3.1 Conic section: parabola, ellipse, hyperbola;
    - 6.3.2 Plane: general equation, various form of equation of plane, angle between two planes, angle between line and plane, plane through intersection of two plane, length of perpendicular from a point to a plane, bisector of angle
    - 6.3.3 Sphere: general equation of sphere, equation of sphere with the given diameter, equation of tangent plane on a sphere

## **Part: Two**

### **Teaching Learning Process/Pedagogical Knowledge**

**Full Marks: 25**

- 7. Secondary Level Mathematics Curriculum and Planning: Yearly-Lesson, unit and daily lesson plan, curriculum development models, curriculum design
- 8. Basic Teaching and Learning Strategies: Collaborative and Cooperative, Inductive and Deductive, Analytic and Synthesis, Conceptual and Procedural, Laboratory, Project, Problem Solving, Heuristic
- 9. Cognitive Learning Theories: Piaget's, Bruner's and Vygotsky's learning theories
- 10. Constructivist Learning Theories: Trivial/personal, Social and Radical learning theories
- 11. Cultural Approach of Mathematics Teaching and Learning: culturally contextualized mathematics teaching, culturally responsive pedagogy and ethno-mathematics/ethno-pedagogy
- 12. Development and Use of various resources in mathematics teaching
- 13. Assessment Strategies (Written/Project Work/Presentation/Field Work): Measurement and Evaluation, Formative and Summative Evaluation, CAS, types of test, Standardization of test
- 14. Use of ICT (Information and Communication Technology) in Mathematics Teaching
  - 14.1 ICT for Continuous Professional Development: Information retrieve/search/manage, knowledge on ICT competencies
  - 14.2 ICT for content enhancement: Use of various ICT tools to explore mathematical knowledge
  - 14.3 ICT as a delivery tool: Use of ICT - Mobile, Multi-media, software, online materials, etc. in classroom teaching for specific mathematical contents

**प्रश्ननिर्माण योजना  
(Specification Grid)**

क्र. सं.	पाठ्यक्रमको क्षेत्र	वस्तुगत (बहुवैकल्पिक) प्रश्न			विषयगतप्रश्न			जम्मा	
		प्रश्न संख्या	अङ्क भार दर	जम्मा	प्रश्न संख्या	अङ्क भार	जम्मा	प्रश्न संख्या	अङ्क भार
<b>खण्ड (क) : गणित विषयको विषयवस्तुसम्बन्धी ज्ञान</b>									
१	Set and Number System (Set, Real and Complex Number System and their properties)	७	१	७	-	-	-	७	७
२	Calculus (Limit, Function, Derivative, Anti-Derivative, Curve Sketching)	६	१	६	-	-	-	६	६
३	Discrete Mathematics (Logic, permutation and combination, Mathematical induction, Number Theory, Graph Theory)	७	१	७	-	-	-	७	७
४	Statistics (Central Tendency, Dispersion, Correlation and Regression)	७	१	७	-	-	-	७	७
५	Analysis (Axiomatic Foundation of Real Number, Real Sequence, Infinite Series and infinite product, Riemann integral – integration by parts)	७	१	७	-	-	-	७	७
६	Geometry (Axiomatic System, Euclidian Geometry, Analytical Geometry – Plan, Conic Section, Sphere)	६	१	६	-	-	-	६	६
<b>खण्ड (ख) शिक्षण कला</b>									
७	Secondary Level Mathematics Curriculum and Planning	-	-	-	१	५	५	१	५
८	Basic Teaching and Learning Strategies	-	-	-	१	५	५	१	५
९	Cognitive Learning Theories	-	-	-	१	५	५	१	५
१०	Constructivist Learning Theories	-	-	-	१	५	५	१	५
११	Cultural Approach of Mathematics Teaching and Learning	-	-	-	१	५	५	१	५
१२	Development and Use of various resources in mathematics teaching	-	-	-	१	५	५	१	५
१३	Assessment Strategies	-	-	-	१	५	५	१	५
१४	Use of ICT (Information and Communication Technology) in Mathematics Teaching	-	-	-	१	५	५	१	५
	<b>जम्मा</b>	<b>४०</b>	<b>१</b>	<b>४०</b>	<b>५</b>	<b>५</b>	<b>२५</b>	<b>४५</b>	<b>६५</b>

द्रष्टव्य :

१. प्रश्नपत्रतयार गर्दा संज्ञानात्मक तहका सबैजसो क्षेत्र समेटिने छन् ।
२. विषयगतप्रश्नहरूमाफत सिर्जनशीलता र शिक्षणसँग सम्बन्धितव्यावहारिक पक्षहरू मापन गर्ने उद्देश्य राखिने छ ।
३. कण्ठस्थ गरी दिइएकाजवाफभन्दा शिक्षण सिकाइसँग सम्बन्धितव्यावहारिक पक्षहरूको विश्लेषण/विवेचनातथा समस्याको समाधानगर्दै दिइएका मौलिकतथासिर्जनात्मकउत्तरलाई प्रोत्साहित गरिने छ ।
४. खण्ड (ख) अन्तर्गतका शिक्षणकलासँग सम्बन्धितप्रश्नहरू खण्ड (क) मा दिइएकाविषयहरूको व्यवहारिक पक्षसँग जोडेर तयार गरिने छन् ।
५. लामो उत्तर आउने प्रश्नहरू शिक्षणमा सूचनाप्रविधिको प्रयोगलाई समेत ध्यानदिइने छ ।

4. नमूना प्रश्नपत्रहरू (Model/Sample Questions)

**Group A (40 × 1 = 40): Multiple Choice Questions (MCQs)**

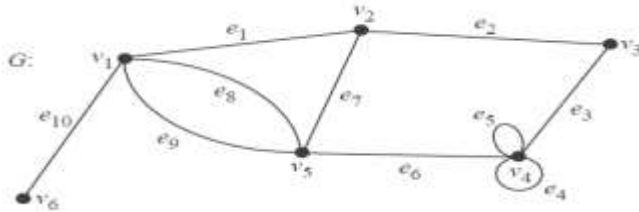
Circle the best alternatives.

- Which one of the following relations is true on the operation on sets?
  - $\overline{A \cup B} = \overline{A} \cup \overline{B}$
  - $\overline{A \cap B} = \overline{A} \cup \overline{B}$
  - $\overline{A \cap B} = \overline{A} \cap \overline{B}$
  - $A - B = A \cup \overline{B}$
- For all real numbers x and y, which one of the following is always true?
  - $|x + y| \geq |x| + |y|$
  - $|x + y| \leq |x| + |y|$
  - $|x + y| < |x| + |y|$
  - $|x + y| > |x| + |y|$
- Which one of the is correct for the value of x in the inequality of  $|2x+3| \leq 1$  ?
  - $-2 \leq x \leq -1$
  - $-2 \leq x \leq 1$
  - $-3 \leq x \leq -1$
  - $-3 \leq x \leq 1$
- The set of  $\mathbb{R}^+$  is:
  - Bounded above and unbounded below
  - Unbounded above and bounded below
  - Bounded neither above nor below
  - Bounded below and above
- If  $(x+iy)(3+2i) = 1+i$  then the value of  $x^2+y^2$  is
  - $13/2$
  - $5/2$
  - $2/5$
  - $2/13$
- Which one of the following is the cube root of unity?
  - 1
  - $\frac{-1-\sqrt{3}i}{2}$
  - $\frac{-1+\sqrt{3}i}{2}$
  - All of above
- The number of all possible subsets of a set with 'n' elements is
  - $n^2$
  - $2^n$
  - n
  - $2^{n-1}$
- Which one of the following is true for the value of limit?
  - $\lim_{x \rightarrow 0} \sin \theta = 1$
  - $\lim_{x \rightarrow 0} \frac{\sin \theta}{\theta} = 1$
  - $\lim_{x \rightarrow 0} \cos \theta = 0$
  - $\lim_{x \rightarrow \pi} \frac{\sin \theta}{\theta} = 1$
- $F: X \rightarrow Y$  is onto if
  - $\forall x_1, x_2 \in X, \text{ if } F(x_1) = F(x_2) \text{ then } x_1 = x_2$
  - $\forall x_1, x_2 \in X, \text{ if } x_1 = x_2 \text{ then } F(x_1) = F(x_2)$
  - $\forall y \in Y, \text{ there exists } x \in X \text{ such that } y = F(x)$
  - Range set = domain Set

10. Which one of the following is not an indeterminate form?
- $\frac{0}{0}$
  - $\frac{\infty}{\infty}$
  - $\infty - \infty$
  - $\frac{0}{\infty}$
11.  $\lim_{x \rightarrow a} f(x)$  does not exist and  $\lim_{x \rightarrow a} -f(x) \neq \lim_{x \rightarrow a} +f(x)$  then, which types of discontinuous is the function  $f(x)$  at  $x=a$ ?
- Removable discontinuity
  - Ordinary discontinuity
  - Infinite discontinuity
  - None of above
12. Which one of the following statements is right?
- The continuity of a function at a point is the sufficient condition for the existence of derivatives at that point
  - The continuity of a function at a point may not be the necessary condition for the existence of derivatives at that point
  - The slope of the tangent at a point  $(x,y)$  of a curve given by a function  $y=f(x)$  is equal to the first derivatives of  $f(x)$
  - All of the above
13. Which one of the following is the vertex of parabola?
- $(\frac{-b}{2a}, \frac{4ac-b^2}{2a})$
  - $(\frac{b}{2a}, \frac{4ac-b^2}{2a})$
  - $(\frac{-b}{2a}, \frac{4ac-b}{2a})$
  - $(\frac{-b}{2a}, \frac{4ac+b^2}{2a})$
14. Which of the following sentence is not a statement?
- $4+7=9$
  - If ABC is a triangle then it has 3 sides.
  - $4 \times 5 = 15$
  - Kathmandu is a beautiful city.
15. Which of the symbolic representation represents 'Exclusive Or'?
- $(p \vee q) \wedge \sim(p \wedge q)$
  - $\sim(p \vee q) \wedge (p \wedge q)$
  - $(p \wedge q) \vee \sim(p \wedge q)$
  - $(p \wedge q) \wedge \sim(p \vee q)$
16. The sum of  $1^2+2^2+\dots+n^2$  is equal to
- $\frac{n(n+1)}{2}$
  - $\frac{n(n+1)(2n+1)}{12}$
  - $\frac{n(n+1)(2n+1)}{6}$
  - $\{\frac{n(n+1)}{2}\}^2$
17. Which one of the following relations is true?
- The square of an odd integer is odd.
  - The square of an odd integer is of the form  $8k+1$ .
  - The product of an even integer and odd integer is even.
  - The product of two odd integers is not odd.
18. Let  $\gcd(a,b) = d$  then which one of the following is not true?

- a)  $\gcd(a,b)$  is unique.
- b)  $d$  can be expressed as the linear combination of  $a$  and  $b$ .
- c) If  $d \neq 1$  then  $a$  and  $b$  are relatively prime.
- d)  $\gcd\left(\frac{a}{d}, \frac{b}{d}\right) = 1$ .

19. Look at the following graph. Which of the statement is not right?



- a.  $e_4$  and  $e_5$  are the loop.
  - b. There is only one pendent vertex.
  - c. The number of odd vertex is even.
  - d. The graph is simple.
20. In how many ways can eight people be seated in a row of eight seats so that two particular persons are always together?
- a. 10080
  - b. 40,320
  - c. 20160
  - d. 5040

Chapter 5: Statistics (Central Tendency, Dispersion, Correlation and Regression)

21. Suppose a TV company has to know the best demanded model of TV among its production, then which types of central tendency fits best?
- a. Mode
  - b. Mean
  - c. Quartile
  - d. Standard deviation
22. If the value of kurtosis of a variable is 5 then the distribution of data is
- a) Mesokurtic
  - b) Leptokurtic
  - c) Platykurtic
  - d) The distribution curve is flat.
23. The value of correlation coefficient ( $r$ ) is 0.76 then it refers
- a) Increase in one variable refers increase in next variable
  - b) Decrease in one variable refers decrease in next variable
  - c) The relationship is direct
  - d) All of above
24. Suppose a questionnaire in a survey form is constructed in likert five-point scale as 5, 4, 3, 2 and 1. Which type of measurement scale is it?
- a) Interval
  - b) Ratio
  - c) Nominal
  - d) Ordinal

25. Which of the following descriptive measurement is not the way of measuring dispersion of a variable?
- Mode
  - Range
  - Quartile deviation
  - Standard deviation
26. The regression analysis table helps
- To predict the value of independent variable on the basis of dependent variable.
  - To explore the possibility in the variability of independent variable in %.
  - To know the value of correlation coefficient
  - All of above
27. If the distribution of a set of data is positively skewed then
- Mean > median > mode
  - Mean < median < mode
  - Mean = median = mode
  - Not defined
28. Every non-empty set of real numbers which is bounded above has a supremum in  $\mathbb{R}$  is
- Field axiom
  - Completeness axiom in  $\mathbb{R}$
  - Order axiom
  - Extend axiom
29. The limit point of a set  $S = \{a + \frac{1}{n} ; n \in \mathbb{N}\}$  is
- 0
  - 1
  - a
  - $\frac{1}{a}$
30. A sequence which is neither convergent nor- divergent is said to be
- Oscillatory sequence
  - Real sequence
  - Monotonic sequence
  - None of the above
31. A function  $f$  is Riemann integrable on  $[a, b]$  if
- $f$  is monotonic on  $[a, b]$
  - $f$  is continuous on  $[a, b]$
  - $f$  has finite set of points of discontinuity on  $(a, b)$
  - All of above
32. The series  $\sum \frac{1}{n^p}$  is convergent if
- $p \leq 1$
  - $p \geq 1$
  - $p < 1$
  - $p > 1$
33. The series  $1 + \frac{1}{3} + \frac{1}{5} + \dots + \frac{1}{2n-1} + \dots$  diverges to
- 0
  - $\infty$
  - $-\infty$
  - $+\infty$
34. The area enclosed by  $y=3x$ , the x-axis and ordinates  $x=0$  and  $x=4$  is
- 12 sq. unit
  - 24 sq. unit
  - 30 sq. unit
  - 36 sq. unit
35. In an ellipse the eccentricity  $e$  is
- 1

- b.  $<1$
  - c.  $>1$
  - d.  $0$
36. The general equation of second degree represents a parabola if
- a.  $h^2=ab$
  - b.  $h^2<ab$
  - c.  $h^2>ab$
  - d.  $h^2<ab$  and  $a+b=0$
37. if  $x, y, z$  are the angles made by a line with the co-ordinate axes the value of  $\sin^2x + \sin^2y + \sin^2z$  is
- a.  $0$
  - b.  $1$
  - c.  $2$
  - d.  $3$
38. The angle between two diagonals of a cube is
- a.  $\cos^{-1}\frac{1}{3}$
  - b.  $\cos^{-1}\frac{1}{\sqrt{3}}$
  - c.  $\cos^{-1}\frac{1}{2}$
  - d.  $\cos^{-1}\frac{1}{\sqrt{2}}$
39. The equation  $x^2 + y^2 - 2xy - 2x - 1 = 0$  represents
- a. Parabola
  - b. Ellipse
  - c. Hyperbola
  - d. Pair of lines
40. The intersection of two planes may be a
- a. Line
  - b. Point
  - c. Plane
  - d. All of above

**Group B (Subjective Questions) (5 × 5 = 25)**

1. What is vertical and horizontal organization of curriculum? Do you feel the curriculum of compulsory mathematics of grade ten is vertically and horizontally well organized? Give your arguments with appropriate evidences.
2. How the processes of learning mathematics among children are different from adult? And, write your understanding about 'how children learn?' with reference to the assumptions of behaviorism, cognitivism and constructivism.
3. Assume that you are introducing "Limit" to your students for the first time. What activities do you perform in the class of 45 minutes? Discuss.
4. How do you use local resources in teaching school mathematics? Choose any one of the mathematical concepts from grades 9-12 (based on school curriculum) and discuss the use of local resources to teach that concept.
5. CAS (Continuous Assessment System) is assumed as one of the best tools/approaches for assessing overall performance of the students. Do you agree with this statement? Justify your arguments.