

Sample Test

Mathematics

Exercise 1 – Vocabulary (10 points)

Complete each gap with a suitable word. The definition and/or synonym (in brackets and in *italics*) of the target words have been provided. In some cases the first letter is also provided.

One of the most _s_____ (*important, notable*) developments in the history of mathematics was the development of calculus in the 17th century. The _____ (*idea, thought*) of a limit is fundamental to understanding both differential and integral calculus. Isaac Newton and Gottfried Wilhelm Leibniz are generally _c_____ (acknowledged) as the co-inventors of calculus, though they developed it _i_____ (separately, on their own).

The study of calculus involves two main branches: differential calculus, which deals with rates of change, and integral calculus, _c_____ with (dealing) the accumulation of quantities. Both branches are connected by the _f_____ (*basic*) theorem of calculus. A function is said to be differentiable at a point if its derivative exists at that point.

In the 19th century, mathematicians began to place calculus on a more _r_____ (*strict, exact*) footing. The epsilon-delta definition of a limit, formulated by Augustin-Louis Cauchy, eliminated the need to rely on _a_____ (*not having a fixed value, unclear*) notions of _____ (*without end, boundlessly*) small quantities. This paved the way for modern mathematical analysis as a _d_____ (*field, area of study*).

Exercise 2 – Word Formation (10 points)

Put the words in brackets into the correct part of speech and form to complete the sentences.

Number Theory

Number theory is a branch of mathematics devoted primarily to the study of integers and integer-valued functions. The _____ (*to distribute*) of prime numbers among the integers is a central topic. According to the Prime Number Theorem, the _____ (*approximate*) number of primes less than a given number n is $n / \ln(n)$.

One of the most famous results in number theory is Fermat's Last Theorem, whose _____ (*to prove*) eluded mathematicians for over 350 years. The theorem states that no three positive integers can _____ (*satisfaction*) the equation $a^n + b^n = c^n$ for any integer value of n greater than two. Andrew Wiles achieved the _____ (*to demonstrate*) of this theorem in 1994. His proof, though _____ (*exception*) complex, was eventually verified. The field has seen remarkable progress in recent decades, making previously _____ (*solve*) problems accessible. Number theorists work both _____ (*theory*) and _____ (*computation*) to explore the _____ (*deep*) of integer relationships.

Exercise 3 – Grammar (10 points)

Circle the correct answer: A, B, C, or D.

- 1) Mathematicians ____ that every even integer greater than 2 ____ as the sum of two primes, a conjecture known as Goldbach's Conjecture.

A) believe; can be expressed
B) believed; expressed

C) are believing; is expressing
D) will believe; had been expressed

- 2) The concept of infinity ____ mathematicians for centuries, and it ____ into several distinct types by Georg Cantor in the 19th century.
- A) fascinates; is classifying
B) has fascinated; was classified
C) had fascinated; classified
D) fascinated; will have been classified
- 3) In order ____ complex problems, mathematicians often find it helpful ____ a visual representation first.
- A) solve; drawing
B) to solve; to draw
C) solving; draw
D) to solve; drawing
- 4) If you ____ a fair six-sided die, the probability that you ____ an odd number is exactly one-half.
- A) roll; will get
B) rolled; get
C) will roll; got
D) roll; had gotten
- 5) A vector space is a mathematical structure ____ elements, called vectors, can be added together and multiplied by scalars.
- A) which
B) whom
C) where
D) that
- 6) Although calculus ____ independently by Newton and Leibniz, historians ____ that both men ____ to ideas from earlier mathematicians.
- A) developed; have long believed; were indebted
B) was developed; have long believed; were indebted
C) had been developing; believe long; owe
D) is developed; are believing; owed
- 7) There is ____ evidence that ancient Babylonians had knowledge of what we now call the Pythagorean theorem.
- A) a few
B) few
C) much
D) many
- 8) Topology is ____ branch of mathematics that studies ____ properties of ____ geometric objects that are preserved under continuous deformations.
- A) $\emptyset$; the; the
B) a; the; $\emptyset$
C) a; the; the
D) the; a; a
- 9) The relationship ____ algebra and geometry was made explicit by René Descartes through the introduction of the coordinate system.
- A) among
B) between
C) within
D) of
- 10) An irrational number is one that ____ expressed as a ratio of two integers.
- A) cannot be
B) must not
C) ought be
D) will not have been

Exercise 4 – Symbolic Notation (10 points)

Write down symbolically – using digits, letters, and mathematical symbols. When only a set is given, choose any suitable number from that set.

e.g. the square root of sixteen equals four = $\sqrt{16} = 4$

- 1) The absolute value of negative nine _____
- 2) The mixed number five and four eighths _____
- 3) Set A is a proper subset of set B _____
- 4) The definite integral of f of x from a to b _____
- 5) The square root of the sum of a squared and b squared _____
- 6) The derivative of y with respect to x _____
- 7) Five factorial _____
- 8) Point P has coordinates negative three and positive seven _____
- 9) The limit of f of x as x approaches infinity _____
- 10) Angle ABC measures ninety degrees _____

Exercise 5 – Terminology (20 points)

Put a suitable word or phrase into each gap.

- 1) _____ notation of a set is a notation in which its elements are listed, separated by commas and enclosed in braces { }
- 2) The result of a subtraction problem is called the _____.
- 3) A natural number greater than 2 is not a prime number, and then it is called a _____ number.
- 4) A _____ is a line that has one end point and may be extended only in one direction.
- 5) A set containing only one element is called a _____.
- 6) The set of natural numbers and zero yields the set of _____ numbers.
- 7) Every even number is divisible by number 2 with no _r_____.
- 8) An angle having more than 90° but less than 180° is an _____ angle.
- 9) The _____ of 2 and 3 is 6.
- 10) A _____ triangle is a triangle in which all the sides have different length.
- 11) Two expressions joined together by an equality sign form an _____.
- 12) A Cartesian coordinate system in a plane is formed by taking two mutually _____ real number lines intersecting at their origins (coordinate axes), one horizontal and one vertical, and then assigning unique ordered pairs of numbers (coordinates) to each point P in the plane.
- 13) If A is a subset of (but not equal to) B, then A is called a _____, in other words a subset which is not the same as the original set itself.
- 14) In a fraction, the _____ indicates the number of equal parts into which the unit is to be divided.
- 15) The _____ measures how spread out the values in a data set are from the mean.

- 16) _____ is the distance around the circle/the outer edge of a circle.
- 17) Decimals such as 0.2 and 0.375 are called _____ decimals, because at some point in the division a remainder of zero is obtained.
- 18) The _____ solids are also called the regular solids or regular polyhedra. In a regular polyhedron all the faces are identical regular polygons making equal angles with each other. There are exactly _____ such solids.
- 19) The _____ of a set A is the set of all the elements in the given universal set U that are not in the set A. The notation for this is A' .

Exercise 6 – Text Completion (10 points)

Complete the paragraph using one word (noun, verb, preposition, article, etc.) or nothing (use a dash "-") for each gap. In some cases more than one answer is possible.

Graph theory is _____ branch _____ mathematics that studies the properties of networks made up of nodes and edges. A graph consists _____ a set of vertices connected _____ edges, which may be directed _____ undirected. One of the most famous problems in graph theory was _____ Seven Bridges of Königsberg, solved _____ Euler in 1736. He _____ that it was impossible to walk through the city crossing each bridge exactly once, and _____ doing so, he laid the _____ of both graph theory and topology.

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