GRE®

GRADUATE
RECORD
EXAMINATIONS®

MATHEMATICS TEST

Descriptive Booklet

1997 – 1999

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Educational Testing Service
Princeton, NJ 08541-0001

Committee of Examiners for the Mathematics Test

Selected with the advice of the
Mathematical Association of America

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Practice Tests Available

GRE Subject Test practice books are available for each of the Subject Tests. Each book **includes at least one test that was actually administered,** answer sheets, correct answers, and data on how students who took the test performed on each question. Score conversion information is also provided to enable you to calculate your scaled score. Practice books may be ordered with a credit card (VISA, MasterCard, or American Express only) by calling 1-800-537-3160. Outside the U.S. or Canada, call 1-609-771-7243. Practice books may also be ordered on the registration form in the *GRE Information and Registration Bulletin* or from the GRE website at http://www.gre.org.

You may want to keep this booklet until after you receive your score report. It contains important information about content specifications on which your scores are based.

Table of Contents

Purpose of the GRE Subject Tests

The GRE Subject Tests are designed to help graduate school admission committees and fellowship sponsors assess the qualifications of applicants in specific fields of study. The tests also provide you with an assessment of your own qualifications.

Scores on the tests are intended to indicate knowledge of the subject matter emphasized in many undergraduate programs as preparation for graduate study. Since past achievement is usually a good indicator of future performance, the scores are helpful in predicting success in graduate study. Because the tests are standardized, the test scores permit comparison of students from different institutions with different undergraduate programs. For some Subject Tests, subscores are provided in addition to the total score; these subscores indicate the strengths and weaknesses of your preparation, and they may help you plan future studies.

The GRE Board recommends that scores on the Subject Tests be considered in conjunction with other relevant information about applicants. Because numerous factors influence success in graduate school, reliance on a single measure to predict success is not advisable. Other indicators of competence typically include undergraduate transcripts showing courses taken and grades earned, letters of recommendation, and GRE General Test scores. For information about the appropriate use of GRE scores, write to: GRE Program, Educational Testing Service, Mail Stop 51-L, Princeton, NJ 08541.

Preparing for a Subject Test

GRE Subject Test questions are designed to measure skills and knowledge gained over a long period of time. Although you might increase your scores to some extent through preparation a few weeks or months before you take the test, last minute cramming is

unlikely to be of further help. The following information will help guide you if you decide to spend time preparing for the test.

- A general review of your college courses is probably the best preparation for the test. However, the test covers a broad range of subject matter, and no one is expected to be familiar with the content of every question.
- Use official GRE publications, published by ETS, to familiarize yourself with questions used on the GRE Subject Tests. This descriptive booklet provides several sample questions. In addition. Subject Test practice books are available (see page 2).
- Become familiar with the types of questions used in the test, paying special attention to the directions. If you thoroughly understand the directions before you take the test, you will have more time during the test to focus on the questions themselves.

Test-Taking Strategies

The types of multiple-choice questions in the test are illustrated by the sample questions at the back of this booklet. When you take the test, you will be marking your answers on a separate machine-scorable answer sheet. Total testing time is two hours and fifty minutes; there are no separately timed sections. Following are some general test-taking strategies you may want to consider.

- Read the test directions carefully, and work as rapidly as you can without being careless. For each question, you should choose the best answer from the available options.
- All questions are of equal value; do not waste time pondering individual questions you find extremely difficult or unfamiliar.
- You may want to work through the test quite rapidly, first answering only the questions about which you feel confident, then going back and answering questions that require more thought, and concluding with the most difficult questions if there is time.
- If you decide to change an answer, make sure you completely erase it and fill in the oval corresponding to your desired answer.
- Questions for which you mark no answer or more than one answer are not counted in scoring.
- As a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly are subtracted from the number of questions you answer correctly. It is improbable that mere guessing will improve your score significantly; it may even lower your score. If. however, you are not certain of the correct answer but have some knowledge of the question and are able to eliminate one or more of the answer choices, your chance of getting the right answer is improved, and it may be to your advantage to answer such a question.

- Record all answers on your answer sheet. Answers recorded in your test book will not be counted.
- Do not wait until the last five minutes of a testing session to record answers on your answer sheet.

Development of the Subject Tests

Each new edition of a Subject Test is developed by a committee of examiners composed of professors in the subject who are on undergraduate and graduate faculties in different types of institutions and in different regions of the United States. In selecting members for each committee, the GRE Program seeks the advice of the appropriate professional associations in the subject.

The content and scope of each test are specified and reviewed periodically by the committee of examiners. Test questions are written by the committee and by other faculty who are also subject-matter specialists and by subject-matter specialists at ETS. All questions proposed for the test are reviewed by the committee and revised as necessary. The accepted questions are assembled into a test in accordance with the content specifications developed by the committee to ensure adequate coverage of the various aspects of the field and at the same time to prevent overemphasis on any single topic. The entire test is then reviewed and approved by the committee.

Subject-matter and measurement specialists on the ETS staff assist the committee, providing information and advice about methods of test construction and helping to prepare the questions and assemble the test. In addition, individual test questions and the test as a whole are reviewed to eliminate language, symbols, or content considered to be potentially offensive, inappropriate for major subgroups of the test-taking population, or serving to perpetuate any negative attitude that may be conveyed to these subgroups. The test as a whole is also reviewed to make sure that the test questions, where applicable, include an appropriate balance of people in different groups and different roles.

Because of the diversity of undergraduate curricula, it is not possible for a single test to cover all the material you may have studied. The examiners, therefore, select questions that test the basic knowledge and skills most important for successful graduate study in the particular field. The committee keeps the test up-to-date by regularly developing new editions and revising existing editions. In this way, the test content changes steadily but gradually, much like most curricula. In addition, curriculum surveys are conducted periodically to ensure that the content of a test reflects what is currently being taught in the undergraduate curriculum.

After a new edition of a Subject Test is first administered, examinees' responses to each test question are analyzed in a variety of ways to determine whether each question functioned as expected. These analyses may reveal that a question is ambiguous.

requires knowledge beyond the scope of the test, or is inappropriate for the total group or a particular subgroup of examinees taking the test. Answers to such questions are not used in computing scores.

Following this analysis, the new test edition is equated to an existing test edition. In the equating process, statistical methods are used to assess the difficulty of the new test. Then scores are adjusted so that examinees who took a difficult edition of the test are not penalized, and examinees who took an easier edition of the test do not have an advantage. Variations in the number of questions in the different editions of the test are also taken into account in this process.

Scores on the Subject Tests are reported as three-digit scaled scores with the third digit always zero. The maximum possible range for all Subject Test total scores is from 200 to 990. The actual range of scores for a particular Subject Test, however, may be smaller. The maximum possible range of Subject Test subscores is 20 to 99; however, the actual range of subscores for any test or test edition may be smaller than 20 to 99. Subject Test score interpretive information is provided in *Interpreting Your GRE General and Subject Test Scores*, which you will receive with your GRE Report of Scores.

What Your Scores Mean

Your raw score, that is, the number of questions you answered correctly minus one-fourth of the number you answered incorrectly, is converted to the scaled score that is reported. This conversion ensures that a scaled score reported for any edition of a Subject Test is comparable to the same scaled score earned on any other edition of the same Subject Test. Thus, equal scaled scores on a particular Subject Test indicate essentially equal levels of performance regardless of the test edition taken. Test scores should be compared only with other scores on the same Subject Test. (For example, a 680 on the Computer Science Test is not equivalent to a 680 on the Mathematics Test.)

Before taking the test, it may be useful to know approximately what raw scores would be required to obtain a certain scaled score. Several factors influence the conversion of your raw score to your scaled score, such as the difficulty of the test edition and the number of test questions included in the computation of your raw score. Based on recent editions of the Mathematics Test, the table on the next page gives the range of raw scores associated with selected scaled scores for three different test editions. (Note that when the number of scored questions for a given test is greater than the range of possible scaled scores, it is likely that two or more raw scores will convert to the same scaled score.) The three test editions in the table that follows were selected to reflect varying degrees of difficulty. Examinees should note that future test editions may be somewhat more or less difficult than those test editions illustrated in the table.

Range of Raw Scores* Needed to Earn Selected Scaled Scores
on Three Different Mathematics Test Editions

Scaled Score	Raw Scores		
	Form A	Form B	Form C
900	47	40	38
800	37	32	29
700	27	23	20
600	18	15	11
Number of Questions Used to Compute Raw Score	66	66	66

*Raw Score = Number of correct answers minus one-fourth the number of incorrect answers, rounded to the nearest integer.

For a particular test edition, there are many ways to earn the same raw score. For example, on the edition listed above as "Form A," a raw score of 27 would earn a scaled score of 700. Below are a few of the possible ways in which a scaled score of 700 could be earned on that edition.

Examples of Ways to Earn a Scaled Score of 700
on the Edition Labeled as "Form A"

Raw Score	Questions Answered Correctly	Questions Answered Incorrectly	Questions Not Answered	Number of Questions Used to Compute Raw Score
27	27	0	39	66
27	31	15	20	66
27	34	29	3	66

CONTENT OF THE MATHEMATICS TEST

The test usually consists of 66 multiple-choice questions, some of which may be grouped in sets and based on such materials as diagrams and graphs. The questions are drawn from the courses of study most commonly offered at the undergraduate level. Approximately 50 percent of the questions involve calculus and its applications—subject matter that can be assumed to be common to the backgrounds of almost all mathematics majors. About 25 percent of the questions in the test are in elementary algebra, linear algebra, abstract algebra, and number theory. The remaining portion consists of questions on real and complex analysis as well as questions from several diverse areas of mathematics currently offered to undergraduates in many institutions.

To assist students in preparing for the test, the following content descriptions are presented. The percentages given are approximate; actual percentages will vary slightly from one edition of the test to another.

Calculus (50%)

The usual material of two years of calculus, including trigonometry, coordinate geometry, introductory differential equations, and applications based on the calculus.

Algebra (25%)

Elementary algebra: the kind of algebra taught in precalculus courses.

Linear algebra: matrices, linear transformations, characteristic polynomials, eigenvectors, and other standard material.

Abstract algebra and number theory: topics from the elementary theory of groups, rings, and fields; elementary topics from number theory.

Additional Topics (25%)

Introductory real variable theory as presented in courses, such as those entitled Advanced Calculus or Methods of Real Analysis, that include the elementary topology of the line, plane, 3-space, and n-space, as well as Riemann and elementary Lebesgue integration; other areas such as complex variables, probability and statistics, set theory, logic, combinatorial analysis, general topology, numerical analysis, and algorithmic processes.

There may also be questions that ask the test taker to match "real-life" situations to appropriate mathematical models.

The above descriptions of topics covered in the test should not be considered exhaustive; it is necessary to understand many other related concepts. Knowledge of the material included in the descriptions is a necessary, but not sufficient, condition for correctly answering the questions on the test; and prospective test takers should be aware that a substantial number of questions requiring no more than a good precalculus background are analytically quite complex, and some of these turn out to be among the most difficult questions on the test. In general, the questions are intended to test more than the recall of information and concentrate on assessing the test takers' understanding of fundamental concepts and their ability to apply these concepts in various situations.

SAMPLE QUESTIONS

The following questions are similar to those in the test. They illustrate the range of the actual test in terms of the subject-matter areas tested and the difficulty of the questions posed. An answer key appears after the sample questions.

<u>Directions:</u> Each of the questions or incomplete statements below is followed by five suggested answers or completions. In each case select the one that is the best of the choices offered.
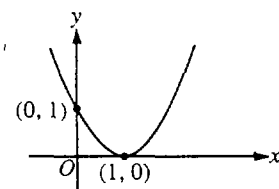

Figure 1

1. Which of the following could be an equation of the curve shown in Figure 1 ?

   (A) $y = x^2 + 1$ (B) $y = (x + 1)^2$ (C) $y = |x - 1|$
   (D) $y = (x - 1)^2$ (E) $y = |x| + x + 1$

2. What is the least upper bound of the set of all numbers A such that a polygon with area A can be inscribed in a semicircular region of radius 1 ?

   (A) $\frac{4}{5}$ (B) $\frac{2}{\sqrt{5}}$ (C) 1   (D) $\frac{\pi}{2}$ (E) 2

3. A certain procedure requires 2^{60} calculations. A programmer decides that, to be useful on his computer, the procedure must be modified so as to require only 2^{20} calculations. If the procedure is modified each day in such a manner that the number of calculations required is exactly one-half that required by the procedure on the previous day, what is the total number of days that will be required to obtain a modification using only 2^{20} calculations?

   (A) 1   (B) 2   (C) 3   (D) 30   (E) 40

4. The solution set for the equation $\begin{vmatrix} 2 & 3 & x \\ 2 & 1 & x^2 \\ 6 & 7 & 3 \end{vmatrix} = 0$ is

   (A) the empty set   (B) $\{0\}$ (C) $\{1\}$ (D) $\{1, -3\}$ (E) $\{\sqrt{3}, -\sqrt{3}\}$

5. If $f(x) = x|x|$ for all real numbers x, then $f'(x)$ is a real number for

   (A) no real number x
   (B) $x = 0$ only
   (C) $x > 0$ only
   (D) $x \neq 0$ only
   (E) all real numbers x

6. If f is a function having derivatives of all orders and if $f'(x) = (f(x))^2$, then the nth derivative of f at x is given by

   (A) $n(f(x))^n$ (B) $n!(f(x))^{n+1}$ (C) $(n + 1)!(f(x))^{n+1}$
   (D) $(n + 1)(f(x))^n$ (E) $n(f(x))^{2n}$

7. Let p and q be constants. If $f(x) = p \sin x + qx \cos x + x^2$ for all real numbers x and if $f(2) = 3$, then $f(-2)$ is

   (A) -3 (B) -1 (C) 1   (D) 5
   (E) not uniquely determined by the information given

8. Let f be a continuous function such that for all $c > 0$,

   (i) $f(c) > 0$ and
   (ii) the region bounded by the line $x = c$, by the coordinate axes, and by the curve with equation $y = f(x)$ has area ce^c.

   For all $x > 0$, $f(x) =$

   (A) e^x (B) xe^x (C) $xe^x - e^x$ (D) $xe^x + e^x$ (E) $x^2e^x - xe^x$

9. If the binary operation $*$ is defined for all integers by $a * b = a + b - ab$, then the properties of $*$ include which of the following?

   I. $*$ is commutative.
   II. $*$ is associative.
   III. There exists some integer that is an identity for $*$.

   (A) I only   (B) III only   (C) I and II only
   (D) I and III only   (E) I, II, and III

10. Which of the following is an equation of the curve through the origin that intersects at right angles all the curves satisfying the differential equation $\frac{dy}{dx} = x + 1$?

   (A) $e^{-y} = x + 1$ (B) $e^y + x - 1 = 0$ (C) $e^y = x + 1$
   (D) $2y = x^2 + 2x$ (E) $y(x^2 + 2x) = -2$

11. If x and y are integers such that $x \geq 3$ and $x - y \geq 9$, then the minimum possible value of $3x + 7y$ is

   (A) -33 (B) 0   (C) 9   (D) 27   (E) nonexistent

12. The interval of convergence of the series

   $$\sum_{n=1}^{\infty} \frac{(x - 1)^n}{n^3 2^{n+2}} \text{ is indicated by}$$

   (A) $-1 < x < 1$ (B) $-1 \leq x \leq 1$ (C) $-1 < x < 3$
   (D) $-1 \leq x \leq 3$ (E) $0 \leq x \leq 2$

13. Let f be a continuous function of x (f not identically zero) and let s and t be nonzero numbers. If $I = t \int_0^{\frac{s}{t}} f(s + tx)\, dx$, then the value of I

   (A) varies with x

   (B) depends on the ratio $\frac{s}{t}$

   (C) depends on s, but is independent of t and x

   (D) depends on t, but is independent of s and x

   (E) is constant for all s, t, and x

14. Let x and y be integers such that $9x + 5y$ is divisible by 11. For which of the following values of k must $10x + ky$ be divisible by 11 ?

   (A) 0   (B) 1   (C) 3   (D) 7   (E) 8

15. If T is the linear transformation mapping the vectors $(1,0,0)$, $(0,1,0)$, and $(0,0,1)$ to the vectors $(2,2,1)$, $(1,1,2)$, and $(0,0,1)$, respectively, which of the following is the image of the vector $(2,3,4)$ under T ?

   (A) $(7,7,12)$ (B) $(7,7,11)$ (C) $(7,7,8)$ (D) $(6,6,11)$ (E) $(3,3,4)$

16. If f is infinitely differentiable everywhere, then

   $$\lim_{k \to 0}\left[\lim_{h \to 0} \frac{f(p + k + h) - f(p + k) - f(p + h) + f(p)}{hk}\right] =$$

   (A) $f'(p)$ (B) $f''(p)$ (C) $(f'(p))^2$ (D) $f'(f'(p))$ (E) $f'(h)f'(k)$

17. Alternately a fair coin is tossed and a fair die is thrown, beginning with the coin. What is the probability that the coin will register a "head" before the die registers a "5" or a "6" ?

   (A) $\frac{1}{3}$ (B) $\frac{1}{2}$ (C) $\frac{3}{5}$ (D) $\frac{2}{3}$ (E) $\frac{3}{4}$

18. If $f(x) = x^{\left(\frac{1}{x-1}\right)}$ for all positive $x \neq 1$ and if f is continuous at 1, then $f(1)$ is

   (A) 0   (B) $\frac{1}{e}$ (C) 1   (D) e

   (E) none of the above

19. Suppose that H is a nonempty subset of a multiplicative group G and that H is closed under the group operation. Which of the following conditions is NOT sufficient to ensure that H is a subgroup of G ?

   (A) The identity element of G is in H.
   (B) Every element of H has a unique inverse in H.
   (C) If $x, y \in H$, then $xy^{-1} \in H$.
   (D) If $x, y \in H$, then $x^{-1}y^{-1} \in H$.
   (E) If $y \notin H$, then $y^{-1} \notin H$.

20. Let A and B be topological spaces. let f be a mapping from A to B, and let f^{-1} be the inverse of f. Under which of the following conditions must f be continuous?

(A) The image under f of any open set in A is an open set in B.

(B) The image under f of any closed set in A is a closed set in B.

(C) The image under f of any bounded set in A is a bounded set in B.

(D) The image under f^{-1} of any open set in B is an open set in A.

(E) The image under f^{-1} of any discrete set in B is a discrete set in A.

21. In the process of constructing a highway across a certain region in which there are many hills and valleys. the engineer will be certain that

> there is some level in between the elevations of the highest hill and the lowest valley at which the surface of the highway can be laid using the tops of the hills as fill material for the valleys and such that no additional fill dirt need be brought in from another region and none will be left to be hauled away.

To build a mathematical model of this situation, let S be a long, narrow rectangular region (the roadbed) bounded by the lines $x = a$, $x = b$, $y = c$. and $y = d$; let f be a continuous function on S with M and m being, respectively. the maximum and minimum values of f on S. If the graph of f is identified with the surface of the land, then, of the following, which best corresponds to the assertion set off in braces above?

(A) There exists a point p in S such that $m \leq f(p) \leq M$.

(B) There exists a value q of f such that $M - m = q$.

(C) There exists a point p in S such that $\iint\limits_{S} f = f(p) \cdot (\text{area of } S)$.

(D) $\int_a^b \left(\int_c^d f(x, y)dy \right) dx = \left. \frac{\partial f}{\partial x} \right|_{(a, b)} + \left. \frac{\partial f}{\partial y} \right|_{(c, d)}$

(E) There exists a value q of f such that $\dfrac{q}{(\text{area of } S)} = \left. \frac{\partial f}{\partial x} \right|_{(a, b)} + \left. \frac{\partial f}{\partial y} \right|_{(c, d)}$

22. Consider the following algorithm.

Step 1. Set $h = k = 2$

Step 2. Set $s_1 = 2$

Step 3. If $k > 100$ then stop

Step 4. Increase h by 1

Step 5. If h is NOT divisible by any of $s_1^{\,2}, \ldots, s_{k-1}^{\,2}$

then set $s_k = h$ and increase k by 1

Step 6. Go to step 3

The sequence $\{s_k\}$ produced by this algorithm is the sequence of

(A) prime numbers less than 100

(B) the first 100 prime numbers

(C) the integers n such that $1 < n < 100$ and no square of an integer except 1 divides n

(D) the first 100 integers $n > 1$ such that no square of an integer except 1 divides n

(E) the integers n such that $1 < n < 100$ and n is not the square of an integer

23. Each of two sets of data, D_1 and D_2, is divided into categories, C_1 and C_2, and the following table is devised to record the number of data in each category.

	C_1	C_2
D_1		
D_2		

Furthermore, there are two systems of weights, W_1 and W_2, each of which assigns a score for each datum in each category, and the following table is devised to show the score assigned to each category under each system of weights.

	W_1	W_2
C_1		
C_2		

Let x_{ij} be the number of elements of D_i that are put into category C_j. Let y_{ij} be the weight assigned to C_i under the system W_j. If $X = \begin{pmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{pmatrix}$ and $Y = \begin{pmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{pmatrix}$, which of the following would be the matrix of entries showing the total score of set D_i under W_j ?

(A) $X + Y$ (B) XY (C) YX (D) XYX^{-1} (E) YXY^{-1}

24. Of the following equations, which has the greatest number of roots between 100 and 1,000 ?

(A) $\sin x = 0$ (B) $\sin(x^2) = 0$ (C) $\sin\sqrt{|x|} = 0$

(D) $\sin(x^3) = 0$ (E) $\sin\sqrt[3]{x} = 0$

25. If $f(x) = \begin{cases} \dfrac{x}{|x|} & \text{if } x \neq 0 \\ 1 & \text{if } x = 0 \end{cases}$, then $\displaystyle\int_{-1}^{3} f(x)\, dx =$

(A) $-e$ (B) $-\log 2$ (C) 1 (D) 2 (E) e

26. Two planes P and Q intersect at an angle of $30°$. Two distinct rays, one in P and one in Q, form an angle of $x°$ with its vertex in the intersection of P and Q. What is the least possible value of x ?

(A) 30 (B) 36 (C) 45 (D) 90 (E) There is no least possible value of x.

27. If f is a continuous real-valued function with domain a closed interval $[a, b]$ such that $f'(x) = 0$ for one and only one number x between a and b, then f

(A) might not have a maximum on $[a, b]$
(B) cannot have an even number of extrema on $[a, b]$
(C) cannot have a maximum at one endpoint and a minimum at the other
(D) might be monotonically increasing
(E) might be unbounded

28. Which of the following is equal to the product $P^{-1} \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} P$ for some invertible 2×2 matrix P ?

(A) $\begin{pmatrix} 3 & 4 \\ 1 & 2 \end{pmatrix}$ (B) $\begin{pmatrix} 2 & 2 \\ 3 & 2 \end{pmatrix}$ (C) $\begin{pmatrix} 2 & 0 \\ 0 & 0 \end{pmatrix}$ (D) $\begin{pmatrix} 4 & 3 \\ 2 & 1 \end{pmatrix}$ (E) $\begin{pmatrix} 2 & 1 \\ 4 & 3 \end{pmatrix}$

29. Which of the following correctly describe the graph G in the xy-plane of
$y = \frac{1}{x} \sin \frac{1}{x}$?

    I. G does not intersect any line $y = c$, where $c < 0$.
    II. G contains infinitely many points $(x, 0)$ with $0 < x < 1$.
    III. G contains no points $(x, 0)$ with $1 < x$.

(A) I only   (B) II only   (C) III only   (D) I and III   (E) II and III

30. The order of the element $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 4 & 5 & 1 & 3 & 2 \end{pmatrix}$ of the symmetric group S_5 is

(A) 2   (B) 3   (C) 6   (D) 8   (E) 12

31. If f is a continuous, decreasing function defined on the positive reals and its graph is concave upward, then the graph of the inverse function f^{-1} is

(A)   decreasing and concave upward
(B)   decreasing and concave downward
(C)   increasing and concave upward
(D)   increasing and concave downward
(E)   not necessarily any of the above

32. How many different solutions, modulo 24, does the congruence $18x \equiv 12 \pmod{24}$ have?

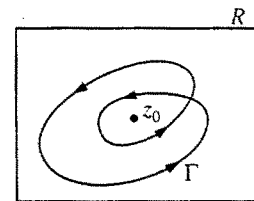(A) None   (B) One   (C) Three   (D) Six   (E) Twelve

Figure 2

33. Let f be analytic in a region R with the single exception of point z_0. If the residue of f at z_0 is 1, what is the value of $\int_\Gamma f(z)dz$, where Γ is the path shown in Figure 2 ?

(A) 0   (B) 1   (C) 2   (D) $2\pi i$ (E) $4\pi i$

34. Let f be a function with domain $[-1, 1]$ such that the coordinates of each point (x, y) of its graph satisfy $x^2 + y^2 = 1$. The total number of points at which f is necessarily continuous is

(A) zero   (B) one   (C) two   (D) four   (E) infinite

35. If $A = \begin{pmatrix} 2 & 1 \\ 3 & -1 \end{pmatrix}$ and $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, which of the following matrices is zero?

(A) $A^2 - A - 5I$ (B) $A^2 + A - 5I$ (C) $A^2 + A - I$
(D) $A^2 - 4I$ (E) $A^2 - 3A + 5I$

Answer Key

1. D	8. D	15. A	22. D	29. E
2. D	9. E	16. B	23. B	30. C
3. E	10. A	17. E	24. D	31. A
4. D	11. E	18. D	25. D	32. D
5. E	12. D	19. A	26. E	33. E
6. B	13. C	20. D	27. D	34. C
7. D	14. E	21. C	28. D	35. A