CLEP®

Test Information Guide: College-Level Examination Program®

2015-16

College Algebra

CollegeBoard

CLEP TEST INFORMATION GUIDE FOR COLLEGE ALGEBRA

History of CLEP

Since 1967, the College-Level Examination Program (CLEP®) has provided over six million people with the opportunity to reach their educational goals. CLEP participants have received college credit for knowledge and expertise they have gained through prior course work, independent study or work and life experience.

Over the years, the CLEP examinations have evolved to keep pace with changing curricula and pedagogy. Typically, the examinations represent material taught in introductory college-level courses from all areas of the college curriculum. Students may choose from 33 different subject areas in which to demonstrate their mastery of college-level material.

Today, more than 2,900 colleges and universities recognize and grant credit for CLEP.

Philosophy of CLEP

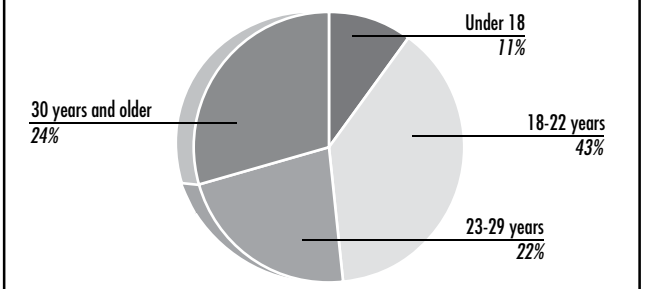
Promoting access to higher education is CLEP's foundation. CLEP offers students an opportunity to demonstrate and receive validation of their college-level skills and knowledge. Students who achieve an appropriate score on a CLEP exam can enrich their college experience with higher-level courses in their major field of study, expand their horizons by taking a wider array of electives and avoid repetition of material that they already know.

CLEP Participants

CLEP's test-taking population includes people of all ages and walks of life. Traditional 18- to 22-year-old students, adults just entering or returning to school, high-school students, home-schoolers and international students who need to quantify their knowledge have all been assisted by CLEP in earning their college degrees. Currently, 59 percent of CLEP's National (civilian) test-takers are women and 46 percent are 23 years of age or older.

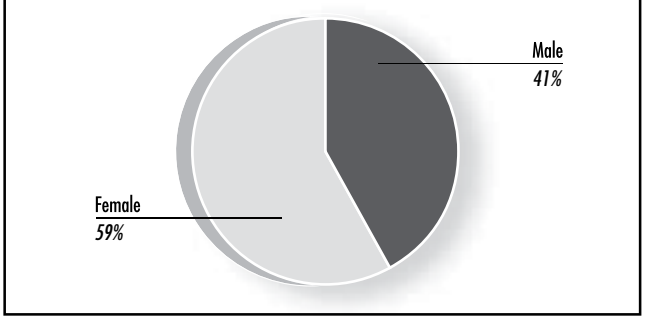
For over 30 years, the College Board has worked to provide government-funded credit-by-exam opportunities to the military through CLEP. Military service members are fully funded for their CLEP exam fees. Exams are administered at military installations worldwide through computer-based testing programs. Approximately one-third of all CLEP candidates are military service members.

2014-15 National CLEP Candidates by Age*



* These data are based on 100% of CLEP test-takers who responded to this survey question during their examinations.

2014-15 National CLEP Candidates by Gender



Computer-Based CLEP Testing

The computer-based format of CLEP exams allows for a number of key features. These include:

- a variety of question formats that ensure effective assessment
- real-time score reporting that gives students and colleges the ability to make immediate credit-granting decisions (except College Composition, which requires faculty scoring of essays twice a month)
- a uniform recommended credit-granting score of 50 for all exams
- "rights-only" scoring, which awards one point per correct answer
- pretest questions that are not scored but provide current candidate population data and allow for rapid expansion of question pools

CLEP Exam Development

Content development for each of the CLEP exams is directed by a test development committee. Each committee is composed of faculty from a wide variety of institutions who are currently teaching the relevant college undergraduate courses. The committee members establish the test specifications based on feedback from a national curriculum survey; recommend credit-granting scores and standards; develop and select test questions; review statistical data and prepare descriptive material for use by faculty (*Test Information Guides*) and students planning to take the tests (*CLEP Official Study Guide*).

College faculty also participate in CLEP in other ways: they convene periodically as part of standard-setting panels to determine the recommended level of student competency for the granting of college credit; they are called upon to write exam questions and to review exam forms; and they help to ensure the continuing relevance of the CLEP examinations through the curriculum surveys.

The Curriculum Survey

The first step in the construction of a CLEP exam is a curriculum survey. Its main purpose is to obtain information needed to develop test-content specifications that reflect the current college curriculum and to recognize anticipated changes in the field. The surveys of college faculty are conducted in each subject every few years depending on the discipline. Specifically, the survey gathers information on:

- the major content and skill areas covered in the equivalent course and the proportion of the course devoted to each area
- specific topics taught and the emphasis given to each topic
- specific skills students are expected to acquire and the relative emphasis given to them
- recent and anticipated changes in course content, skills and topics
- the primary textbooks and supplementary learning resources used
- titles and lengths of college courses that correspond to the CLEP exam

The Committee

The College Board appoints standing committees of college faculty for each test title in the CLEP battery. Committee members usually serve a term of up to four years. Each committee works with content specialists at Educational Testing Service to establish test specifications and develop the tests. Listed below are the current committee members and their institutional affiliations.

Mark A. Crawford, *Chair*	Waubonsee Community College
Borislava Gutarts	California State University — Los Angeles
Derek Martinez	University of New Mexico

The primary objective of the committee is to produce tests with good content validity. CLEP tests must be rigorous and relevant to the discipline and the appropriate courses. While the consensus of the committee members is that this test has high content validity for a typical introductory College Algebra course or curriculum, the validity of the content for a specific course or curriculum is best determined locally through careful review and comparison of test content, with instructional content covered in a particular course or curriculum.

The Committee Meeting

The exam is developed from a pool of questions written by committee members and outside question writers. All questions that will be scored on a CLEP exam have been pretested; those that pass a rigorous statistical analysis for content relevance, difficulty, fairness and correlation with assessment criteria are added to the pool. These questions are compiled by test development specialists according to the test specifications, and are presented to all the committee members for a final review. Before convening at a two- or three-day committee meeting, the members have a chance to review the test specifications and the pool of questions available for possible inclusion in the exam.

At the meeting, the committee determines whether the questions are appropriate for the test and, if not, whether they need to be reworked and pretested again to ensure that they are accurate and unambiguous. Finally, draft forms of the exam are reviewed to ensure comparable levels of difficulty and content specifications on the various test forms. The committee is also responsible for writing and developing pretest questions. These questions are administered to candidates who take the examination and provide valuable statistical feedback on student performance under operational conditions.

Once the questions are developed and pretested, tests are assembled in one of two ways. In some cases, test forms are assembled in their entirety. These forms are of comparable difficulty and are therefore interchangeable. More commonly, questions are assembled into smaller, content-specific units called testlets, which can then be combined in different ways to create multiple test forms. This method allows many different forms to be assembled from a pool of questions.

Test Specifications

Test content specifications are determined primarily through the curriculum survey, the expertise of the committee and test development specialists, the recommendations of appropriate councils and conferences, textbook reviews and other appropriate sources of information. Content specifications take into account:

- the purpose of the test
- the intended test-taker population
- the titles and descriptions of courses the test is designed to reflect
- the specific subject matter and abilities to be tested
- the length of the test, types of questions and instructions to be used

Recommendation of the American Council on Education (ACE)

The American Council on Education's College Credit Recommendation Service (ACE CREDIT) has evaluated CLEP processes and procedures for developing, administering and scoring the exams. Effective July 2001, ACE recommended a uniform credit-granting score of 50 across all subjects (with additional Level-2 recommendations for the world language examinations), representing the performance of students who earn a grade of C in the corresponding course. Every test title has a minimum score of **20**, a maximum score of **80** and a cut score of **50**. However, these score values cannot be compared across exams. The score scale is set so that a score of **50** represents the performance expected of a typical C student, which may differ from one subject to another. The score scale is not based on actual performance of test-takers. It is derived from the judgment of a panel of experts (college faculty who teach an equivalent course) who provide information on the level of student performance that would be necessary to receive college credit in the course.

Over the years, the CLEP examinations have been adapted to adjust to changes in curricula and pedagogy. As academic disciplines evolve, college faculty incorporate new methods and theory into their courses. CLEP examinations are revised to reflect those changes so the examinations continue to meet the needs of colleges and students. The CLEP program's most recent ACE CREDIT review was held in June 2015.

The American Council on Education, the major coordinating body for all the nation's higher education institutions, seeks to provide leadership and a unifying voice on key higher education issues and to influence public policy through advocacy, research and program initiatives. For more information, visit the ACE CREDIT website at www.acenet.edu/acecredit.

CLEP Credit Granting

CLEP uses a common recommended credit-granting score of 50 for all CLEP exams.

This common credit-granting score does not mean, however, that the standards for all CLEP exams are the same. When a new or revised version of a test is introduced, the program conducts a standard setting to determine the recommended credit-granting score ("cut score").

A standard-setting panel, consisting of 15–20 faculty members from colleges and universities across the country who are currently teaching the course, is appointed to give its expert judgment on the level of student performance that would be necessary to receive college credit in the course. The panel reviews the test and test specifications and defines the capabilities of the typical A student, as well as those of the typical B, C and D students.* Expected individual student performance is rated by each panelist on each question. The combined average of the ratings is used to determine a recommended number of examination questions that must be answered correctly to mirror classroom performance of typical B and C students in the related course. The panel's findings are given to members of the test development committee who, with the help of Educational Testing Service and College Board psychometric specialists, make a final determination on which raw scores are equivalent to B and C levels of performance.

*Student performance for the language exams (French, German and Spanish) is defined only at the B and C levels.

College Algebra

Description of the Examination

The College Algebra examination covers material that is usually taught in a one-semester college course in algebra. Nearly half of the test is made up of routine problems requiring basic algebraic skills; the remainder involves solving nonroutine problems in which candidates must demonstrate their understanding of concepts. The test includes questions on basic algebraic operations; linear and quadratic equations, inequalities and graphs; algebraic, exponential and logarithmic functions; and miscellaneous other topics. It is assumed that candidates are familiar with currently taught algebraic vocabulary, symbols and notation. The test places little emphasis on arithmetic calculations. However, an online scientific calculator (nongraphing) will be available during the examination.

The examination contains approximately 60 questions to be answered in 90 minutes. Some of these are pretest questions that will not be scored. Any time candidates spend on tutorials and providing personal information is in addition to the actual testing time.

Knowledge and Skills Required

Questions on the College Algebra examination require candidates to demonstrate the following abilities in the approximate proportions indicated.

- Solving routine, straightforward problems (about 50 percent of the examination)
- Solving nonroutine problems requiring an understanding of concepts and the application of skills and concepts (about 50 percent of the examination)

The subject matter of the College Algebra examination is drawn from the following topics. The percentages next to the main topics indicate the approximate percentage of exam questions on that topic.

25% **Algebraic Operations**

Operations with exponents
Factoring and expanding polynomials
Operations with algebraic expressions
Absolute value
Properties of logarithms

25% **Equations and Inequalities**

Linear equations and inequalities
Quadratic equations and inequalities
Absolute value equations and inequalities
Systems of equations and inequalities
Exponential and logarithmic equations

30% **Functions and Their Properties***

Definition, interpretation and representation/modeling (graphical, numerical, symbolic, verbal)
Domain and range
Evaluation of functions
Algebra of functions
Graphs and their properties (including intercepts, symmetry, transformations)
Inverse functions

20% **Number Systems and Operations**

Real numbers
Complex numbers
Sequences and series
Factorials and Binomial Theorem

*Each test may contain a variety of functions, including linear, polynomial (degree ≤ 5), rational, absolute value, power, exponential, logarithmic and piecewise-defined.

Sample Test Questions

The following sample questions do not appear on an actual CLEP examination. They are intended to give potential test-takers an indication of the format and difficulty level of the examination and to provide content for practice and review. Knowing the correct answers to all of the sample questions is not a guarantee of satisfactory performance on the exam.

Directions: An online scientific calculator will be available for the questions in this test.

Some questions will require you to select from among five choices. For these questions, select the BEST of the choices given.

Some questions will require you to type a numerical answer in the box provided.

Notes: (1) Unless otherwise specified, the domain of any function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

(2) i will be used to denote $\sqrt{-1}$.

(3) Figures that accompany questions are intended to provide information useful in answering the questions. All figures lie in a plane unless otherwise indicated. The figures are drawn as accurately as possible EXCEPT when it is stated in a specific question that the figure is not drawn to scale. Straight lines and smooth curves may appear slightly jagged on the screen.

1. Which of the following expressions is equivalent to $(3 - 5b)^2$?

   (A) $9 - 25b^2$
   (B) $9 + 25b^2$
   (C) $9 - 15b - 25b^2$
   (D) $9 + 30b - 25b^2$
   (E) $9 - 30b + 25b^2$

2. Which of the following is a factor of $4-(x+y)^2$?

   (A) $-(x+y)^2$
   (B) $x+y$
   (C) $2-x+y$
   (D) $2+x+y$
   (E) $4+x+y$

3. $2v(3v^2-1)-(6-8v^3+14v)+3=$

   (A) $-2v^3+12v-3$
   (B) $14v^3+12v-3$
   (C) $14v^3-14v-4$
   (D) $14v^3-16v-3$
   (E) $14v^3-16v-6$

4. The radius of the Sun is approximately 10^9 meters, and the radius of an oxygen atom is approximately 10^{-12} meter. The radius of the Sun is approximately how many times the radius of an oxygen atom?

   (A) 10^{-21}
   (B) 10^{-3}
   (C) 10^3
   (D) 10^9
   (E) 10^{21}

5. Where defined, $\dfrac{\dfrac{x^2-9}{x+2}}{\dfrac{x-3}{x-2}} =$

   (A) $\dfrac{x-2}{x+2}$
   (B) $\dfrac{(x-2)(x+3)}{x+2}$
   (C) $\dfrac{x^2-x+6}{x+2}$
   (D) $\dfrac{1}{(x-2)(x+2)}$
   (E) $\dfrac{x+3}{(x-2)(x+2)}$

6. Which of the following are solutions of the equation $(2x - 3)(3x + 5) = -14$?

(A) $x = \frac{1}{3}$ and $x = -\frac{1}{2}$

(B) $x = -\frac{1}{3}$ and $x = \frac{1}{2}$

(C) $x = \frac{3}{2}$ and $x = -\frac{5}{3}$

(D) $x = -\frac{3}{2}$ and $x = \frac{5}{3}$

(E) $x = 2$ and $x = -7$

7. Of the following, which is greatest?

(A) $2^{\left(3^5\right)}$

(B) $\left(2^3\right)^5$

(C) $3^{\left(2^5\right)}$

(D) $\left(3^2\right)^5$

(E) $5^{\left(3^2\right)}$

8. For any positive integer n, $\frac{(n+1)!}{n!} - n =$

(A) 0 (B) 1 (C) n (D) $n+1$ (E) $n!$

9. Which of the following is equal to $r^2t^{1/2}r^{2/3}t^{-3/2}$?

(A) $-r^{8/3}t$

(B) $\frac{r^{4/3}}{t^{3/4}}$

(C) $\frac{r^{4/3}}{t}$

(D) $\frac{r^{5/2}}{t^{5/6}}$

(E) $\frac{r^{8/3}}{t}$

10. A ball is dropped from a height of h feet and repeatedly bounces off the floor. After each bounce, the ball reaches a height that is $\frac{2}{3}$ of the height from which it previously fell. For example, after the first bounce, the ball reaches a height of $\frac{2}{3}h$ feet. Which of the following represents the total number of feet the ball travels between the first and the sixth bounce?

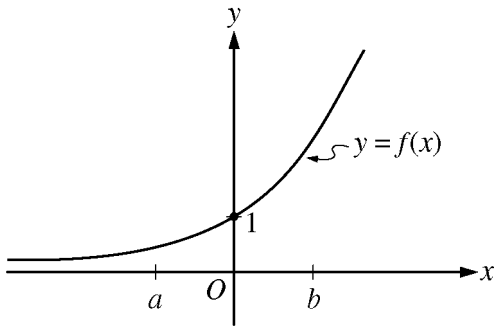
(A) $\sum_{i=1}^{5}(2h)\left(\frac{2}{3}\right)^i$

(B) $\sum_{i=1}^{5}h\left(\frac{2}{3}\right)^i$

(C) $\sum_{i=1}^{5}\left(\frac{2}{3}h\right)^i$

(D) $\sum_{i=1}^{6}(2h)\left(\frac{2}{3}\right)^{i-1}$

(E) $\sum_{i=1}^{\infty}h\left(\frac{2}{3}\right)^i$



11. The graph shows an exponential function f in the xy-plane. The function g is defined by $g(x) = 2^{-x}$. Complete each sentence in the table by indicating the correct relationship between the two values.

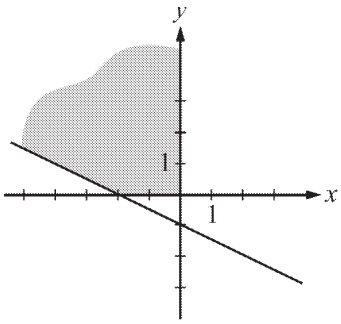
	less than	greater than	equal to	
$f(a)$ is				$g(a)$.
$f(b)$ is				$g(b)$.
$f(0)$ is				$g(0)$.

12. Which of the following defines the interval of real numbers $[-4, 2]$?

(A) $|x - 0| \le 2$
(B) $|x + 1| \le 3$
(C) $|x + 1| \ge 3$
(D) $|x - 4| \le 2$
(E) $|x - 4| \ge 2$

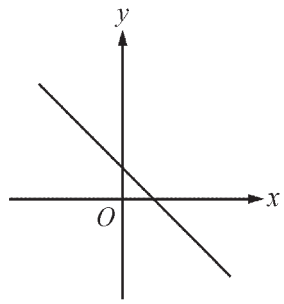
13. Which of the following are the solutions of the equation $2x^2 + 2x = 4 - x$?

(A) $x = 4$ and $x = 1$
(B) $x = 4$ and $x = -\frac{1}{2}$
(C) $x = \frac{3+\sqrt{35}}{4}$ and $x = \frac{3-\sqrt{35}}{4}$
(D) $x = \frac{-3+\sqrt{41}}{4}$ and $x = \frac{-3-\sqrt{41}}{4}$
(E) $x = \frac{-3+i\sqrt{23}}{2}$ and $x = \frac{-3-i\sqrt{23}}{2}$



14. The shaded region in the figure above represents the intersection of the graphs of $x \le 0$, $y \ge 0$, and which of the following inequalities?

(A) $y \le -2x - 1$
(B) $y \le -\frac{1}{2}x + 1$
(C) $y \ge -2x - 1$
(D) $y \ge -\frac{1}{2}x - 1$
(E) $y \ge \frac{1}{2}x - 1$



15. The graph of the line with equation $ax + by = 1$ is shown above. Which of the following must be true?

(A) $a > 0$ and $b < 0$
(B) $a > 0$ and $b > 0$
(C) $a < 0$ and $b < 0$
(D) $a < 0$ and $b > 0$
(E) $a = 0$ and $b > 0$

16. What are all the values of b for which the equation $9x^2 + bx + 1 = 0$ has no real solutions?

(A) $b = -6$ or $b = 6$
(B) $b < -6$ or $b > 6$
(C) $b \le -6$ or $b \ge 6$
(D) $-6 < b < 6$
(E) $-6 \le b \le 6$

17. Which quadrants of the xy-plane contain points of the graph of $2x - y > 4$?

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

18. Joe invests $40,000 and, at the same time, Tom invests $10,000. The value of Joe's investment decreases by $4,000 per year, while the value of Tom's investment increases by $1,000 per year. Which of the following systems of equations could be used to find the number of years, t, that it will take for the values, v, of the two investments to be equal?

(A) $v = 40{,}000 - t$ and $v = 10{,}000 + t$
(B) $v = 40{,}000 - 4t$ and $v = 10{,}000 + t$
(C) $v = 40{,}000 + 1{,}000t$ and $v = 10{,}000 - 4{,}000t$
(D) $v = 40{,}000 + 4{,}000t$ and $v = 10{,}000 - 1{,}000t$
(E) $v = 40{,}000 - 4{,}000t$ and $v = 10{,}000 + 1{,}000t$

19. Which of the following is an equation of the line that passes through the points (–2, 1) and (1, 2) in the xy-plane?

(A) $x + 3y = 1$
(B) $x + 3y = 5$
(C) $x + 3y = -5$
(D) $x - 3y = -5$
(E) $x - 3y = -1$

20. If x is an irrational number, which of the following statements must be true?

(A) x^3 is an irrational number.
(B) x^2 is an irrational number.
(C) $x + x$ is an irrational number.
(D) x^2 is a rational number.
(E) $x + x$ is a rational number.

21. When $\frac{3+4i}{2+i}$ is expressed in the form $a+bi$, what is the value of a?

22. If $a < 0 < b < c$, then each of the following must be true EXCEPT

(A) $ac < ab$
(B) $a^2 < b^2 < c^2$
(C) $a^3 < b^3 < c^3$
(D) $ab < b^2 < bc$
(E) $a^2b < a^2c$

23. The illuminance of a surface varies inversely with the square of its distance from the light source. If the illuminance of a surface is 120 lumens per square meter when its distance from a certain light source is 6 meters, by how many meters should the distance of the surface from the source be increased to reduce its illuminance to 30 lumens per square meter?

(A) 3
(B) 6
(C) 12
(D) 15
(E) 18

24. What are all real values of x for which $\frac{2}{3-x} = \frac{1}{3} - \frac{1}{x}$?

(A) $x = -3$ only
(B) $x = 3$ only
(C) $x = -3$ and $x = 0$
(D) $x = -3$ and $x = 3$
(E) There are no real solutions.

25. Indicate whether each statement is always true, never true, or sometimes true for the real numbers a and b.

Statement	Always True	Never True	Sometimes True
$\|a+b\| = \|a\| + \|b\|$			
$\|a+b\| < \|a\| + \|b\|$			
$\|a+b\| \leq \|a\| + \|b\|$			
$\|a+b\| > \|a\| + \|b\|$			

x	0	1	2	3	4	5	6	7
$p(x)$	−30	22	110	150	34	−130	222	2,350

26. The table above gives some of the values of a 5th degree polynomial $p(x)$. Based on the values shown, what is the minimum number of real roots of the equation $p(x) = 0$?

(A) One
(B) Two
(C) Three
(D) Four
(E) Five

27. The number of bricks in the bottom row of a brick wall is 49. The next row up from the bottom contains 47 bricks, and each subsequent row contains 2 fewer bricks than the row immediately below it. The number of bricks in the top row is 3. If the wall is one brick thick, what is the total number of bricks in the wall?

28. Which of the following is the expansion of $(2x + 3)^3$?

(A) $2x^3 + 3(2x^2) + 3(2x) + 1$
(B) $2x^3 + 3(2x^2) + 3^2(2x) + 3$
(C) $2x^3 + 3(2x^2) + 3^2(2x) + 3^3$
(D) $(2x)^3 + 3(2x)^2 + 3^2(2x) + 3^3$
(E) $(2x)^3 + 3^2(2x)^2 + 3^3(2x) + 3^3$

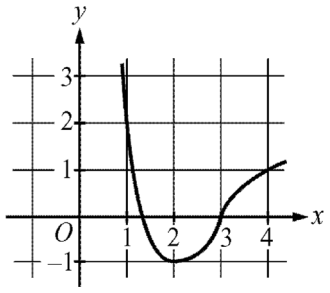
29. If $x = -3$ is a root of the equation $x^3 + 3x^2 - ax - 12 = 0$, what is the value of a ?

30. If the first term of a geometric sequence is $\frac{3}{2}$ and the second and third terms are $-\frac{3}{4}$ and $\frac{3}{8}$, respectively, which of the following represents the nth term of the sequence?

(A) $\frac{3(-1)^{n-1}}{2n}$
(B) $\frac{3(-1)^{n}}{2n}$
(C) $\frac{3(-1)^{n-1}}{2^n}$
(D) $\frac{3(-1)^{n}}{2^n}$
(E) $\frac{3(-1)^{n-1}}{2^{n+1}}$

31. A clothing company has budgeted $58,000 for the purchase of 7 sewing machines. The 7 sewing machines are to be chosen from two models, model X and model Y. If a model X sewing machine costs $8,000 and a model Y sewing machine costs $9,000, how many model X sewing machines should the company purchase to use exactly the budgeted money?

(A) 2 (B) 3 (C) 4 (D) 5 (E) 6



32. The graph of the function f is shown above. What is the value of $f(f(1))$?

(A) −1 (B) 0 (C) 1 (D) 2 (E) 4

33. In the xy-plane, what is the x-intercept of the graph of $y = -\frac{2}{3}x - 4$?

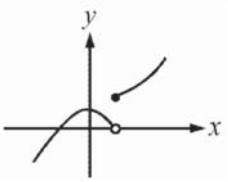
34. Which of the following define y as a function of x ?

I. $2x^2 + y = 7$

II.

x	1	2	3	4
y	2	5	−1	2

III.



(A) None
(B) I and II only
(C) I and III only
(D) II and III only
(E) I, II, and III

35. If $3^{x+1} = 9^{2x-1}$, then x =

36. Select two of the following choices and place them in the blanks below so that the resulting statements are true.

$M(t) = 210(0.89)^t$	155
$M(t) = 210(0.11)^t$	117
$M(t) = 11(210)^t$	28

A patient takes a 210-milligram dose of medicine. The amount of medicine present in the body decreases by 11 percent each hour after it is taken. The amount of medicine M present in the body t hours after the medicine is taken can be modeled by the function _____. According to the model, _____ milligrams of the medicine are present in the body 5 hours after the medicine is taken.

37. If $f(x) = 2x + 1$ and $g(x) = 3x - 1$, then $f(g(x)) =$

(A) $5x$
(B) $x - 2$
(C) $6x - 1$
(D) $6x + 2$
(E) $6x^2 + x - 1$

38. If $\log_4 (y + 2) = 3$, what is the value of y ?

(A) 10 (B) 62 (C) 64 (D) 79 (E) 83

39. A colony of bacteria starts with 2 bacteria at noon. If the number of bacteria triples every 30 minutes, how many bacteria will be present at 3:00 P.M. on the same day?

(A) 486
(B) 729
(C) 1,458
(D) 46,656
(E) 118,098

40. Which of the following must be true?

I. $\log_3 3^t = t$
II. $\ln 10^{4.3} = 4.3 \ln 10$
III. $\log_{10}\left(xy^n\right) = \log_{10} x + n \log_{10} y$ for all positive numbers x and y

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

41. If $f(x) = 5 - 2x^3$ and f^{-1} denotes the inverse function of f, then $f^{-1}(x) =$

(A) $\sqrt[3]{\dfrac{5-x}{2}}$

(B) $\dfrac{\sqrt[3]{5-x}}{2}$

(C) $\sqrt[3]{\dfrac{x-5}{2}}$

(D) $\dfrac{1}{5-2x^3}$

(E) $5x^3 + 2$

42. $\dfrac{2x-1}{x+3} - \dfrac{x-2}{2x+1} =$

(A) $\dfrac{x+1}{3x+4}$

(B) $\dfrac{x-3}{(x+3)(2x+1)}$

(C) $\dfrac{3x-3}{(x+3)(2x+1)}$

(D) $\dfrac{3x^2-x+5}{(x+3)(2x+1)}$

(E) $\dfrac{3x^2+x-7}{(x+3)(2x+1)}$

43. In the xy-plane, the point (8, 10) lies on the graph of the function $y = f(x)$. Which of the following points must lie on the graph of the function $y = 2f(x - 3) + 5$?

(A) (5, 10)

(B) (5, 15)

(C) (5, 25)

(D) (11, 15)

(E) (11, 25)

44. $(i+1)(3-i) + (2i-1) =$

(A) –6
(B) $1 + 4i$
(C) $2 + 4i$
(D) $3 + 4i$
(E) $4 + 2i$

45. The population of a small town is modeled by an exponential function of the form $p(t) = ab^t$, where t represents the number of years since 2010. The population of the town was recorded as 425 in 2010 and 612 in 2012. Based on the data for the years 2010 and 2012, what is the value of b in the model?

46. Which of the following, when added to $4a^2 + 9$, will result in a perfect square for all integer values of a?

(A) 0 (B) $3a$ (C) $6a$ (D) $9a$ (E) $12a$

$$x^2 + y^2 = 25$$
$$x + y = 1$$

47. For what values of x will (x, y) be a solution of the system of equations above?

(A) $x = -4$ and $x = 3$
(B) $x = -4$ and $x = 5$
(C) $x = -3$ and $x = 4$
(D) $x = 1$ and $x = 5$
(E) The system has no solution.

48. A company's daily cost c, in hundreds of dollars, to manufacture n items of a certain product can be modeled by the function $c(n)$. According to the model, which of the following is the best interpretation of $c^{-1}(5) = 80$, where c^{-1} is the inverse function of c?

(A) The company's daily cost to manufacture 5 items of the product is \$80.
(B) The company's daily cost to manufacture 5 items of the product is \$8,000.
(C) The company's daily cost to manufacture 500 items of the product is \$80.
(D) The company's daily cost to manufacture 80 items of the product is \$5.
(E) The company's daily cost to manufacture 80 items of the product is \$500.

$$f(x) = \begin{cases} x^2 & \text{for } x \le 0 \\ ax + b & \text{for } x > 0 \end{cases}$$

49. The function f above has an inverse function for which of the following values of a and b?

(A) $a = -1, b = -2$
(B) $a = -1, b = 2$
(C) $a = 0, b = -1$
(D) $a = 1, b = -2$
(E) $a = 1, b = 2$

50. For the function $g(x) = \log_2 x$, which of the following must be true?

I. The domain is $[0, \infty)$.
II. The range is $(-\infty, \infty)$
III. $g(x)$ increases with increasing values of x.

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

51. A rectangular box has volume $x^3 - 8$ cubic inches. If the height of the box is $x - 2$ inches, what is the area of the base of the box, in square inches? (The volume of a box equals the area of the base times the height.)

(A) $x^2 + 4$
(B) $x^2 - 2x - 4$
(C) $x^2 - 2x + 4$
(D) $x^2 + 2x + 4$
(E) $x^2 + 4x + 4$

52. If $y = 8x^2 + 4x - 1$ is expressed in the form $y = a(x - h)^2 + k$, where a, h, and k are constants, what is the value of k ?

(A) –3
(B) –2
(C) $-\frac{3}{2}$
(D) $-\frac{17}{16}$
(E) $-\frac{1}{2}$

53. If b and c are integers such that the equation $3x^2 + bx + c = 0$ has only one real root, which of the following statements must be true?

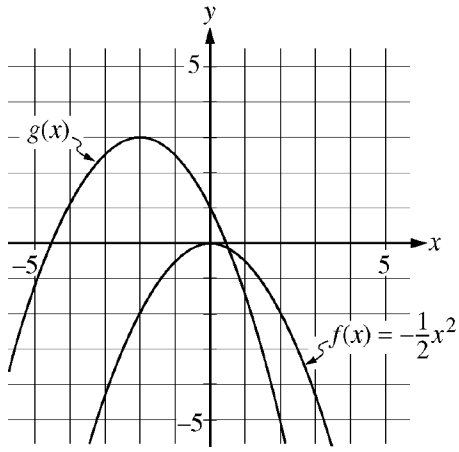
I. b is even.
II. c is odd.
III. b^2 is a multiple of 3.

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

54. A rock is thrown straight up into the air from a height of 4 feet. The height of the rock above the ground, in feet, t seconds after it is thrown is given by $-16t^2 + 56t + 4$. For how many seconds will the height of the rock be at least 28 feet above the ground?

(A) 0.5
(B) 1.5
(C) 2.5
(D) 3.0
(E) 3.5

55. $\log_5 \sqrt{125} - \log_2 \sqrt{2} =$



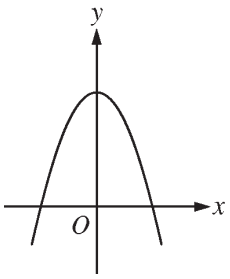
56. In the figure shown above, the graph of the function g is a transformation of the graph of the function f. Which of the following is the equation of g ?

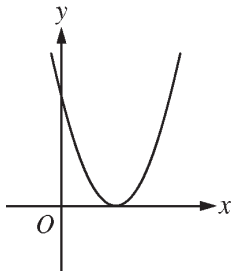
(A) $g(x) = -\frac{1}{2}x^2 + 3$
(B) $g(x) = -\frac{1}{2}(x - 2)^2 + 3$
(C) $g(x) = -\frac{1}{2}(x - 2)^2 - 3$
(D) $g(x) = -\frac{1}{2}(x + 2)^2 + 3$
(E) $g(x) = -\frac{1}{2}(x + 2)^2 - 3$

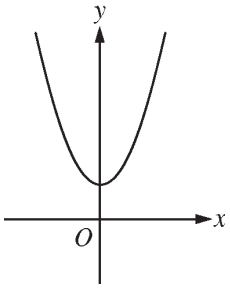
57. The polynomial $p(x) = x^3 + 2x - 11$ has a real zero between which two consecutive integers?

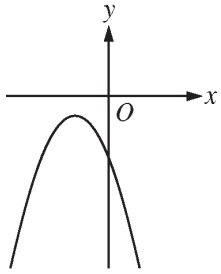
(A) 0 and 1
(B) 1 and 2
(C) 2 and 3
(D) 3 and 4
(E) 4 and 5

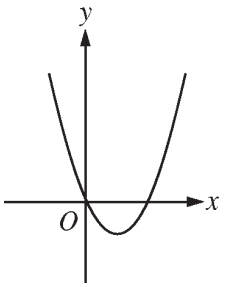
58. Which of the following could be the graph of $y = ax^2 + bx + c$, where $b^2 - 4ac = 0$?

(A)


(B)


(C)


(D)


(E)


59. Consider each function below. Is the domain of the function the set of all real numbers?

Function	Yes	No
$f(x) = \frac{x-1}{x^2+2}$		
$g(x) = \frac{x^2}{x+1}$		
$h(x) = \frac{\sqrt{x}}{x^2+3}$		

60. The sum of the first n terms of an arithmetic sequence $a_1, a_2, a_3, \ldots, a_n$ is $\frac{1}{2}n(a_1 + a_n)$, where a_1 and a_n are the first and the nth terms of the sequence, respectively. What is the sum of the odd integers from 1 to 99, inclusive?

(A) 2,400
(B) 2,450
(C) 2,475
(D) 2,500
(E) 2,550

61. The function f is defined for all real numbers x by $f(x) = ax^2 + bx + c$, where a, b, and c are constants and a is negative. In the xy-plane, the x-coordinate of the vertex of the parabola $y = f(x)$ is –1. If t is a number for which $f(t) > f(0)$, which of the following must be true?

I. $-2 < t < 0$
II. $f(t) < f(-2)$
III. $f(t) > f(1)$

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

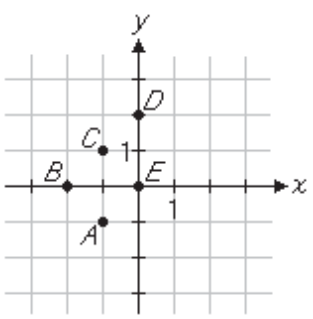
x	$h(x)$
-3	5
-2	-4
2	c

62. The table above shows some values of the function h, which is defined for all real numbers x. If h is an odd function, what is the value of c ?

(A) -5
(B) -4
(C) -2
(D) 2
(E) 4

63. If $\sum_{n=1}^{10} a_n = 50$, what is the value of $\sum_{n=1}^{10}(4a_n + 3)$?

(A) 53
(B) 80
(C) 203
(D) 223
(E) 230



64. If $z = -1 + i$ and $\overline{z}$ denotes the complex conjugate of z, which of the following points in the complex plane above represents $z + \overline{z}$?

(A) A
(B) B
(C) C
(D) D
(E) E

65. What is the remainder when the polynomial $9x^{23} - 7x^{12} - 2x^5 + 1$ is divided by $x + 1$?

(A) -19
(B) -13
(C) -7
(D) 1
(E) 11

66. $f(x) = \sqrt{x+1}$
$g(x) = \sqrt{2-x}$

Functions f and g are defined as shown above. What is the domain of the function $f + g$?

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

67. In the xy-plane, the line given by which of the following is perpendicular to the line $5x - 2y = 7$?

(A) $2x + 5y = 7$
(B) $2x - 5y = 7$
(C) $5x + 2y = 7$
(D) $5x - 2y = 10$
(E) $5x - 5y = 10$

68. Which of the following statements about the polynomial $p(x) = (x-4)^2(x^2+4)$ are true?

I. The polynomial has two imaginary roots.
II. The polynomial has no real roots.
III. The polynomial has four complex roots, counting multiplicities.

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

69.
$$C(x) = 1200 + 1000x$$
$$R(x) = 1200x - x^2$$

For a certain company, the functions shown above model the cost C of producing x units of a product and the revenue R from selling x units of the same product. The profit function P is equal to $R - C$. Which of the following defines the function P ?

(A) $P(x) = x^2 - 200x + 1200$
(B) $P(x) = x^2 + 200x - 1200$
(C) $P(x) = -x^2 + 200x - 1200$
(D) $P(x) = -x^2 + 2200x - 1200$
(E) $P(x) = -x^2 + 2200x + 1200$

70. Which of the following is equivalent to $\dfrac{\sqrt[4]{36}}{\sqrt{6}}$?

(A) $6\sqrt[4]{6}$
(B) $\sqrt[4]{6}$
(C) $\sqrt{6}$
(D) 6
(E) 1

71. If $\log_x 5 = 2$, what is the value of x ?

(A) $\sqrt{5}$
(B) $\sqrt{2}$
(C) $\sqrt[5]{2}$
(D) 2^5
(E) 5^2

72. What is the solution of the equation $4^{2x} = 64$?

(A) $\dfrac{2}{3}$
(B) $\dfrac{3}{2}$
(C) 2
(D) 3
(E) 8

73. The function f is defined by $f(x) = x^2 + 3$. Which of the following is equal to $f(x+5)$?

(A) $x^2 + 8$
(B) $x^2 + 28$
(C) $x^2 + 5x + 8$
(D) $x^2 + 10x + 8$
(E) $x^2 + 10x + 28$

74. The population of a certain city was 10,200 on January 1, 2013. If the population increases by 8 percent per year for the next 3 years, which of the following best approximates the population of the city on January 1, 2016 ?

(A) $10,200(0.8)^3$
(B) $10,200(0.08)^3$
(C) $10,200(1.08)^3$
(D) $10,200 + (0.8)(3)$
(E) $10,200 + (1.08)(3)$

75. What is the value of $f(0)$ for the function $f(x) = \log_{10} 10 + 9^x + (x-2)(x-1)$?

76. If $20 = 3^x$, which of the following expresses x as a base ten logarithm?

(A) $\log_{10} 60$

(B) $(\log_{10} 20) + (\log_{10} 3)$

(C) $(\log_{10} 20) - (\log_{10} 3)$

(D) $(\log_{10} 20)(\log_{10} 3)$

(E) $\dfrac{\log_{10} 20}{\log_{10} 3}$

77. The owner of a small restaurant earned a profit of \$300 during the first month of operation. According to the business model for the next 12 months, it is projected that the profit for each month after the first will be \$50 more than the profit for the preceding month. If $p(m)$ represents the profit for each month m and $m = 1$ represents the first month, which of the following functions describes the business model?

(A) $p(m) = m + 50$

(B) $p(m) = m + 300$

(C) $p(m) = 50m + 250$

(D) $p(m) = 50m + 300$

(E) $p(m) = 300m + 50$

78. When the quadratic functions below are graphed in the xy-plane, is the vertex for each function above the x-axis, below the x-axis, or on the x-axis?

Function	Above	Below	On
$f(x) = x^2 + 3$			
$f(x) = (x+3)^2$			
$f(x) = -x^2 + 3$			
$f(x) = x^2 - 3$			

79. A circular cylindrical water tank is filled with water to 75 percent of its total volume of V cubic inches. The radius of the tank is 6 inches, and the height of the tank is h inches. Which of the following represents the height, in inches, of the water in the tank? (Note: The volume of a cylinder with radius r and height h is given by $\pi r^2 h$.)

(A) $\dfrac{V}{6\pi}$

(B) $\dfrac{V}{8\pi}$

(C) $\dfrac{V}{27\pi}$

(D) $\dfrac{V}{36\pi}$

(E) $\dfrac{V}{48\pi}$

80. Select two of the following choices and place them in the blanks below so that the resulting statement is true.

$f(x) = |x| + 8$ $\quad$ $f(x) = x^2 - 4$ $\quad$ $f(x) = \ln x$

increasing $\quad$ decreasing $\quad$ constant

The function _____ is _____ on its domain.

Study Resources

Most textbooks used in college-level algebra courses cover the topics in the outline given earlier, but the approaches to certain topics and the emphases given to them may differ. To prepare for the College Algebra exam, it is advisable to study one or more college textbooks, which can be found in most college bookstores. When selecting a textbook, check the table of contents against the knowledge and skills required for this test.

Visit clep.collegeboard.org/test-preparation for additional college algebra resources. You can also find suggestions for exam preparation in Chapter IV of the *Official Study Guide*. In addition, many college faculty post their course materials on their schools' websites.

Answer Key

1.	E	40.	E
2.	D	41.	A
3.	D	42.	D
4.	E	43.	E
5.	B	44.	D
6.	A	45.	1.2
7.	A	46.	E
8.	B	47.	C
9.	E	48.	E
10.	A	49.	A
11.	See the following page	50.	D
		51.	D
		52.	C
12.	B	53.	D
13.	D	54.	C
14.	D	55.	1
15.	B	56.	D
16.	D	57.	B
17.	C	58.	B
18.	E	59.	See the following page
19.	D		
20.	C	60.	D
21.	2	61.	C
22.	B	62.	E
23.	B	63.	E
24.	E	64.	B
25.	See the following page	65.	B
		66.	D
		67.	A
26.	C	68.	D
27.	624	69.	C
28.	E	70.	E
29.	4	71.	A
30.	C	72.	B
31.	D	73.	E
32.	A	74.	C
33.	–6	75.	4
34.	E	76.	E
35.	1	77.	C
36.	See the following page	78.	See the following page
		79.	E
37.	C	80.	See the following page
38.	B		
39.	C		

11.

	less than	greater than	equal to	
$f(a)$ is	√			$g(a)$.
$f(b)$ is		√		$g(b)$.
$f(0)$ is			√	$g(0)$.

25.

Statement	Always True	Never True	Sometimes True
$\|a+b\| = \|a\| + \|b\|$			√
$\|a+b\| < \|a\| + \|b\|$			√
$\|a+b\| \le \|a\| + \|b\|$	√		
$\|a+b\| > \|a\| + \|b\|$		√	

36.

The amount of medicine M present in the body at t hours after the medicine is taken can be modeled by the function $M(t) = 210(0.89)^t$. According to the model, 117 mg of the medicine is present in the body at 5 hours after the medicine is taken.

59.

Function	Yes	No
$f(x) = \frac{x-1}{x^2+2}$	√	
$g(x) = \frac{x^2}{x+1}$		√
$h(x) = \frac{\sqrt{x}}{x^2+3}$		√

78.

Function	Above	Below	On
$f(x) = x^2 + 3$	√		
$f(x) = (x+3)^2$			√
$f(x) = -x^2 + 3$	√		
$f(x) = x^2 - 3$		√	

80.

The function $f(x) = \ln x$ is increasing on its domain.

Test Measurement Overview

Format

There are multiple forms of the computer-based test, each containing a predetermined set of scored questions. The examinations are not adaptive. There may be some overlap between different forms of a test: any of the forms may have a few questions, many questions, or no questions in common. Some overlap may be necessary for statistical reasons.

In the computer-based test, not all questions contribute to the candidate's score. Some of the questions presented to the candidate are being pretested for use in future editions of the tests and will not count toward his or her score.

Scoring Information

CLEP examinations are scored without a penalty for incorrect guessing. The candidate's raw score is simply the number of questions answered correctly. However, this raw score is not reported; the raw scores are translated into a scaled score by a process that adjusts for differences in the difficulty of the questions on the various forms of the test.

Scaled Scores

The scaled scores are reported on a scale of 20–80. Because the different forms of the tests are not always exactly equal in difficulty, raw-to-scale conversions may in some cases differ from form to form. The easier a form is judged to be, the higher the raw score required to attain a given scaled score. **Table 1** indicates the relationship between number correct (raw score) and scaled score across all forms.

The Recommended Credit-Granting Score

Table 1 also indicates the recommended credit-granting score, which represents the performance of students earning a grade of C in the corresponding course. The recommended B-level score represents B-level performance in equivalent course work. These scores were established as the result of a Standard Setting Study, the most recent having been conducted in 2005. The recommended credit-granting scores are based upon the judgments of a panel of experts currently teaching equivalent courses at various colleges and universities. These experts evaluate each question in order to determine the raw scores that would correspond to B and C levels of performance. Their judgments are then reviewed by a test development committee, which, in consultation with test content and psychometric specialists, makes a final determination. The standard-setting study is described more fully in the earlier section entitled "CLEP Credit Granting" on page 5.

Panel members participating in the most recent study were:

Gisela Ahlbrandt	Eastern Michigan University
Todd Ashby	Charleston Southern University
Jurg Bolli	University of New Mexico
James Brawner	Armstrong Atlantic State University
Michael Brook	University of Delaware
Harmon Brown	Harding University
Connie Buller	Metropolitan Community College — Elkhorn
CJ Frederick	Oklahoma State University — Oklahoma City
Joe Gallegos	Salt Lake Community College
Brinn Harberts	Big Bend Community College
Lonnie Hass	North Dakota State University
Lynne Kowski	Raritan Valley Community College
Catherine Louchart	Northern Arizona University
Mary Martin	Middle Tennessee State University
John Thurber	Eastern Oregon University
Dan VanPeursem	University of South Dakota
Jane Zegestowsky	Manor College

After the recommended credit-granting scores are determined, a statistical procedure called scaling is applied to establish the exact correspondences between raw and scaled scores. Note that a scaled score of 50 is assigned to the raw score that corresponds to the recommended credit-granting score for C-level performance, and a high but usually less-than-perfect raw score is selected and assigned a scaled score of 80.

Table 1: College Algebra
Interpretive Score Data

American Council on Education (ACE) Recommended Number of Semester Hours of Credit: 3

Course Grade	Scaled Score	Number Correct
	80	50
	79	49
	78	48
	77	47
	76	47
	75	46
	74	45
	73	44
	72	43
	71	42
	70	41-42
	69	40-41
	68	40
	67	39
	66	38
	65	37
	64	36-37
B	**63**	**35-36**
	62	34-35
	61	34
	60	33
	59	32
	58	31
	57	30-31
	56	29-30
	55	29
	54	28
	53	27
	52	26
	51	25-26
C	**50***	**25**
	49	24
	48	23
	47	22
	46	21-22
	45	21
	44	20
	43	19
	42	18
	41	17-18
	40	17
	39	16
	38	15
	37	14
	36	13-14
	35	13
	34	12
	33	11
	32	10
	31	10
	30	9
	29	8
	28	7
	27	7
	26	6
	25	5
	24	-
	23	4
	22	3
	21	2
	20	0-2

*Credit-granting score recommended by ACE.

Note: The number-correct scores for each scaled score on different forms may vary depending on form difficulty.

Validity

Validity is a characteristic of a particular use of the test scores of a group of examinees. If the scores are used to make inferences about the examinees' knowledge of a particular subject, the validity of the scores for that purpose is the extent to which those inferences can be trusted to be accurate.

One type of evidence for the validity of test scores is called content-related evidence of validity. It is usually based upon the judgments of a set of experts who evaluate the extent to which the content of the test is appropriate for the inferences to be made about the examinees' knowledge. The committee that developed the CLEP College Algebra examination selected the content of the test to reflect the content of College Algebra courses at most colleges, as determined by a curriculum survey. Since colleges differ somewhat in the content of the courses they offer, faculty members should, and are urged to, review the content outline and the sample questions to ensure that the test covers core content appropriate to the courses at their college.

Another type of evidence for test-score validity is called criterion-related evidence of validity. It consists of statistical evidence that examinees who score high on the test also do well on other measures of the knowledge or skills the test is being used to measure. Criterion-related evidence for the validity of CLEP scores can be obtained by studies comparing students' CLEP scores with the grades they received in corresponding classes, or other measures of achievement or ability. CLEP and the College Board conduct these studies, called Admitted Class Evaluation Service or ACES, for individual colleges that meet certain criteria at the college's request. Please contact CLEP for more information.

Reliability

The reliability of the test scores of a group of examinees is commonly described by two statistics: the reliability coefficient and the standard error of measurement (SEM). The reliability coefficient is the correlation between the scores those examinees get (or would get) on two independent replications of the measurement process. The reliability coefficient is intended to indicate the stability/consistency of the candidates' test scores, and is often expressed as a number ranging from .00 to 1.00. A value of .00 indicates total lack of stability, while a value of 1.00 indicates perfect stability. The reliability coefficient can be interpreted as the correlation between the scores examinees would earn on two forms of the test that had no questions in common.

Statisticians use an internal-consistency measure to calculate the reliability coefficients for the CLEP exam.[1] This involves looking at the statistical relationships among responses to individual multiple-choice questions to estimate the reliability of the total test score. The SEM is an estimate of the amount by which a typical test-taker's score differs from the average of the scores that a test-taker would have gotten on all possible editions of the test. It is expressed in score units of the test. Intervals extending one standard error above and below the true score for a test-taker will include 68 percent of that test-taker's obtained scores. Similarly, intervals extending two standard errors above and below the true score will include 95 percent of the test-taker's obtained scores. The standard error of measurement is inversely related to the reliability coefficient. If the reliability of the test were 1.00 (if it perfectly measured the candidate's knowledge), the standard error of measurement would be zero.

An additional index of reliability is the conditional standard of error of measurement (CSEM). Since different editions of this exam contain different questions, a test-taker's score would not be exactly the same on all possible editions of the exam. The CSEM indicates how much those scores would vary. It is the typical distance of those scores (all for the same test-taker) from their average. A test-taker's CSEM on a test cannot be computed, but by using the data from many test-takers, it can be estimated. The CSEM estimate reported here is for a test-taker whose average score, over all possible forms of the exam, would be equal to the recommended C-level credit-granting score.

Scores on the CLEP examination in College Algebra are estimated to have a reliability coefficient of 0.90. The standard error of measurement is 3.73 scaled-score points. The conditional standard error of measurement at the recommended C-level credit-granting score is 4.06 scaled-score points.

[1] The formula used is known as Kuder-Richardson 20, or KR-20, which is equivalent to a more general formula called coefficient alpha.

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