Focus on Mathematics

Entry Level Mathematics (ELM) Examination
2002 Edition

Entry Level Mathematics Placement Examination

The California State University (CSU) publishes *Focus on Mathematics* to ensure that high school teachers and students are aware of entry level requirements for admission to and success in the CSU. Students planning to enroll at one of CSU's twenty-three campuses will be joining more than 388,000 students and 21,200 faculty in an academic enterprise requiring college-level skills in reading, writing, and computation. The CSU is committed to ensuring that those who earn degrees from the university possess the knowledge and skills necessary to function in an increasingly complex and technological society. This booklet describes the CSU admission requirements in mathematics and the CSU Entry Level Mathematics (ELM) placement examination developed to ensure that students possess entry-level skills before undertaking baccalaureate coursework in quantitative reasoning.

CSU Admission Requirement in Mathematics

All students in the CSU are required to take college-level courses in mathematics or quantitative reasoning in order to graduate. It is important that all students arrive at the university with the necessary entry-level mathematics skills. If, on entry, a student is found to need additional work in college preparatory subjects and is placed in appropriate remedial coursework, *such remedial coursework will not count toward credit for graduation.*

In order to ensure that students entering the university are ready to take courses in mathematics or quantitative reasoning, freshmen must complete three years of college preparatory coursework (Algebra I, Geometry, and Algebra II). Although not required for admission to the CSU, a fourth year of precalculus mathematics is advisable, especially for students planning to pursue majors in technical fields. This fourth year course is a prerequisite to the freshman calculus courses required in most technical curricula. Students who do not intend to major in technical fields in college may choose a course in statistics and probability in their senior year of high school. *All students are encouraged to take mathematics in their senior year of high school since students whose last math course was completed in the junior year or earlier often have difficulties with the required college-level mathematics courses and with the Entry Level Mathematics (ELM) requirement.*

The Entry Level Mathematics Requirement

The ELM placement examination assesses entry-level mathematics skills that the CSU expects entering students to have acquired in three years of rigorous college preparatory mathematics coursework. Such courses must include the topics covered in elementary and intermediate algebra and two- and three-dimensional geometry, whether offered in traditional or integrated mathematics courses.

All entering students must take the ELM unless they have demonstrated proficiency in mathematics on the SAT, ACT, or Advanced Placement exams (see list below) prior to placement in appropriate university mathematics coursework. This is the ELM requirement. Those who are not exempt must take the ELM placement test prior to enrollment in the CSU. Failure to comply with this requirement will prevent the student from enrolling in the university. Specific policies regarding retesting and placement are determined by each campus. Exemptions from the placement test are given only to those students who can present proof of one of the following.

- A score of 550 or above on the mathematics section of the College Board SAT I: Reasoning Test[1]
- A score of 550 or above on Mathematics Level IC or IIC of the College Board SAT II: Mathematics Test [1]

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[1] NOTE: The College Board SAT and Achievements Tests became the SAT I and SAT II, respectively, beginning March 1994. A new, "recentered" scoring scale has been in effect since April 1995. If you took the SAT before April 1995, contact the campus Admissions and Records Office or Test Office for appropriate exemption scores.

- A score of 23 or above on the ACT Mathematics Test taken October 1989 or later
- A score of 3 or above on the College Board Advanced Placement Calculus AB or Calculus BC examination
- A score of 3 or above on the College Board Advanced Placement Statistics examination
- Completion and transfer to the CSU of a college course that satisfies the requirement in quantitative reasoning, provided such a course was completed with a grade of C or better

Description of the Modified ELM Placement Test

The ELM placement test described in the *Focus on Mathematics* reflects the desire of the CSU mathematics and mathematics education community to build a placement test that assesses mathematical skills needed in campus General Education (GE) programs in quantitative reasoning and to serve the needs of entering students planning both quantitative and nonquantitative courses of study. The placement test was developed over a two-year period by a committee of CSU mathematics professors, mathematics education professors, and chairs of mathematics departments. It differs in several important respects from the ELM placement test that has been in place since January 1999.

The ELM placement test described here will be administered for the first time at the March 23, 2002, systemwide administration. Following are some of the ways in which it differs from its ELM predecessor.

Content
In content, the main difference between the current ELM and its predecessor is one of emphasis. There is more emphasis on working with numbers and data, the connections between algebra and geometry, and problem solving. There is less emphasis on working pure algebra problems. The test provides the major geometric formulae for reference because its purpose is to assess understanding of mathematical concepts and problem-solving skills rather than recall of facts and equations.

The actual topics covered by the current ELM are not very different from those that have been the basis of the placement test since 1992. A few topics have been deleted, but no topics have been added. The placement test is still predicated on the idea that students are responsible for mastering the content of three years of high school mathematics.

Table 1 contains a list of the topics covered by the placement test and shows the proportion of the test devoted to each of the three major content areas: Numbers and Data, Algebra, and Geometry.

Timing
In the past, students were given 75 minutes to complete the ELM, which contained 65 multiple-choice questions. Beginning with the March 23, 2002, administration, the ELM will contain 50 multiple-choice questions. Students will be allotted 90 minutes to complete the test.

Calculators Not Allowed
Beginning with the March 23, 2002, administration, calculators will not be allowed for the ELM placement test. The questions on the ELM do not require involved computation. Rather, the placement test includes problems that emphasize quantitative reasoning and problem solving.

TABLE 1

CSU ELM Topics

NUMBERS AND DATA (approximately 35%)
- ✓ Carry out basic arithmetic calculations
- ✓ Understand and use percent in context
- ✓ Compare and order rational numbers expressed as fractions and/or decimals
- ✓ Solve problems involving fractions and/or decimals in context
- ✓ Interpret and use ratio and proportion in context
- ✓ Use estimation appropriately
- ✓ Evaluate the reasonableness of a solution to a problem
- ✓ Evaluate and estimate square roots
- ✓ Represent and understand data presented graphically (including pie charts, bar and line graphs, histograms, and other formats for presenting data visually used in print and electronic media)
- ✓ Calculate and understand the arithmetic mean
- ✓ Calculate and understand the median
- ✓ Make estimates and predictions based on data
- ✓ Distinguish between reasonable and unreasonable claims based on data

ALGEBRA (approximately 35%)
- ✓ Evaluate and interpret algebraic expressions
- ✓ Simplify algebraic expressions
- ✓ Express relationships among quantities using variables
- ✓ Use properties of exponents
- ✓ Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)
- ✓ Perform arithmetic operations involving rational expressions
- ✓ Solve linear equations (with both numerical and literal coefficients)
- ✓ Solve systems of linear equations in two unknowns
- ✓ Solve linear inequalities
- ✓ Solve problems in context that are modeled by linear equations
- ✓ Solve quadratic and rational equations (with both numerical and literal coefficients; real solutions only)
- ✓ Solve problems in context that are modeled by quadratic equations
- ✓ Solve equations involving absolute value (in one variable)
- ✓ Solve inequalities involving absolute value (in one variable)
- ✓ Find and use slopes and intercepts of lines
- ✓ Use constant and average rates to solve problems in context (using appropriate units)

GEOMETRY (approximately 30%)
- ✓ Find the perimeter, area, or volume of geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, cylinders, and combinations of these figures)
- ✓ Calculate the ratio of corresponding geometric measurements of similar figures (e.g., if the perimeters are in a 3:2 ratio, the areas are in a 9:4 ratio)
- ✓ Use the Pythagorean Theorem
- ✓ Use properties of congruent or similar geometric objects
- ✓ Solve geometric problems using the properties of basic geometric figures (including triangles, quadrilaterals, polygons, and circles)
- ✓ Determine angles in the plane (using properties of intersecting lines, parallel lines, and perpendicular lines)
- ✓ Identify and plot points on the number line
- ✓ Identify and plot points in the coordinate plane
- ✓ Plot points on the graph of a function determined by an algebraic expression
- ✓ Graph linear functions in one variable
- ✓ Graph quadratic functions in one variable
- ✓ Relate basic information about a function to features of its graph (e.g., linearity, positivity or negativity, increasing or decreasing)
- ✓ Find the length or midpoint of a line segment in the coordinate plane

Scores on the ELM Placement Test

As noted previously, the ELM placement test consists of 50 multiple-choice questions. The reported score will be based on forty-five of these questions. The remaining five questions are being field tested for possible use on future tests. **Beginning with the March 23, 2002, administration, score reporting for the ELM will employ a scale of 0-80.** All scores will be reported as even numbers on this scale. The passing scaled score will be 50.

The ELM is reviewed regularly, and new editions are developed several times each year. Therefore, the questions on one edition of the test will not be identical to those on another. However, steps are taken to ensure that each edition represents the same level of difficulty. The inevitable slight differences in difficulty between one edition of the test and another are accommodated through the statistical practice of equating the scores to the ELM scale. A scaled score earned by taking any given ELM test administered on or after March 23, 2002, indicates the same level of proficiency as the same scaled score earned by taking any other given ELM test administered on or after March 23, 2002.

It is extremely important to note that a scaled score earned on the ELM placement test before the March 23, 2002, administration cannot be compared to a scaled score earned by taking the ELM placement test on or after March 23. This is due to the changes incorporated in the ELM administered beginning March 23, 2002: disallowing the use of calculators, giving students more time to take the test, decreasing the number of test questions, and changing the emphasis of what the test measures. To discourage comparisons, the CSU mathematics and mathematics education professors who modified the ELM revised the ELM scale: the 0-80 scale replaces the 100-700 scale that has been in use since the mid-1980's. The score that determines proficiency on the new scale was recommended by a panel of expert judges chosen from faculty in mathematics and related departments throughout the CSU.

Subscores
Starting with score reporting for the March 23, 2002 test, students will receive three scaled subscores—one for each content area (Numbers and Data, Algebra, and Geometry)—as well as a total scaled score. The subscores will be represented graphically as score ranges on the 0-80 scale. The score of 50 which indicates proficiency is indicated by a vertical line on this scale. Figure 1, on the next page, shows a sample student score report.

How the ELM Placement Test is Used
The ELM placement test must be taken by all nonexempt students before they can enroll in the CSU. Students receiving a total scaled score of 50 or above may enroll directly in a baccalaureate quantitative reasoning course. Students receiving a total scaled score below 50 are typically required to take remedial coursework. Campuses have the option of permitting students who score below 50 to take the ELM placement test again after self-study or tutorial.

The subscores are intended to provide guidance in determining the nature of the remediation that best meets a student's needs. However, it is essential to bear in mind that the subscores are less reliable than the total scaled score. The total scaled score is based on all 45 scored test questions while the subscores are based only on subsets of roughly 12 to 18 questions each. To signal the fact that the subscores are less reliable than the total score, they are represented as ranges rather than as single numbers. Only the total score is reliable enough to be represented as a single number.

In addition, subscores are shown as ranges to discourage interpretations of "passing" or "failing" one of the content areas covered by the ELM. A student can demonstrate proficiency on ELM as a whole but the student should not be thought of as "failing" Numbers and Data or "passing" Algebra. In other words, placement decisions should be based on the total score; however, subscores may identify areas of particular need.

So what DO the subscores show? A given student's subscores tell us about that student's performance in the three content areas relative to the performance of other students who took the examination. Thus, a subscore range completely to the left of the cut score marker on the 0-80 axis indicates that a student's performance in that content area ranks with the overall performance of students whose total score is below the cut score. Conversely, a subscore range completely to the right of the cut score marker on the 0-80 scale suggests that a student's performance in the corresponding content area ranks with the overall performance of students whose total score is above the cut score. It is quite possible that a student scoring above the cut score on the test as a whole will rank with fellow test takers whose total score is below the cut score in a particular content area. It is important to remember that the total score is the most important and reliable guide: students who score above the cut score are ready for the first GE mathematics course even if their performance in the three content areas is uneven. By the same token, a student who ranks with the proficient test takers in a given subscore area but whose total score is below the cut score will benefit from some remedial instruction.

A subscore range that straddles the cut-score marker is harder to interpret than one that is entirely to one side of that marker. Typically, students with a total score near the cut score (either "passing" or "failing") will have subscores straddling the cut-score marker. The "passing" students in this group are ready for the first GE course; those whose total score is below the cut score can probably benefit from general review in all three content areas before proceeding to the first GE course.

Students whose total score is well below the cut score probably stand to benefit from more intensive help in all the content areas. If all three subscore ranges are to the left of the cut-score marker, this is almost certainly the case.

The most important caveat to bear in mind is not to overinterpret the subscore ranges. The subscore ranges can provide useful information in thinking about what kind of remediation a given student needs, but interpreting them is an art as much as it is a science. Each student presents an individual case. When in doubt, remember that the total score is the most reliable indicator.

Figure 1: Sample ELM Score Report
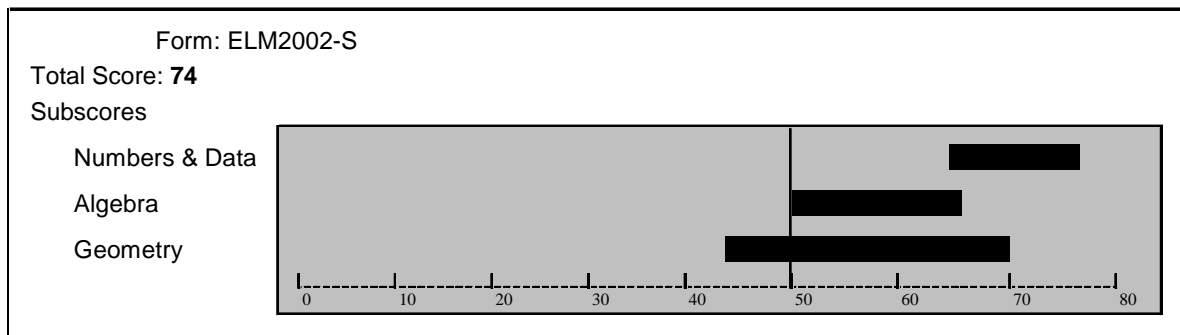
Questions About the ELM Placement Test

Q. **Is this an admission test?**

A. No. The ELM is a placement test designed to determine a student's proficiency in mathematics. The results of the placement test will not affect a student's admission to any CSU campus.

Q. **Can a student who has not yet been admitted take the placement test?**

A. Students should take the placement test upon completion of Algebra II or a higher level mathematics course. If a student passes the placement test as a high school junior, that student will not have to repeat the placement test upon acceptance to the CSU provided he or she has taken a math course during the senior year of high school. If the placement test is not passed earlier, students should take the ELM at the earliest opportunity after admission. Students **must** take the placement test before they can enroll.

Q. **When is the ELM placement test given?**

A. The ELM placement test is given periodically throughout the year. There are three systemwide administrations, when the placement test is given on all campuses on the same date. In addition to the three systemwide administrations (late March, early May, and late June), each campus establishes several additional dates to accommodate local needs. Systemwide and campus dates are published each year and are included in materials sent to applicants. Information about test dates and test registration can be obtained from testing offices on CSU campuses. A full listing of campus test dates is also available online at http://www.ets.org/csu/testdate.html.

Q. **Suppose a student has scored 550 on the math part of the SAT. Does the student still need to take the ELM placement examination?**

A. No. Anyone who scores 550 or above on the mathematics section of the College Board SAT I: Reasoning Test; 550 or above on the Mathematics Level IC or IIC of the College Board SAT II: Mathematics Test; 23 or above on the ACT Math test given October 1989 or later; or 3 or above on an AP mathematics test (Calculus AB, Calculus BC, or Statistics) demonstrates proficiency in mathematics and is exempt from the ELM placement test. Students also may be exempt through transferred coursework. See pages 1 and 2 of this publication for more details.

Q. **What about the CSU/UC Mathematics Diagnostic Testing Project (MDTP) tests? Does a student who does well on these tests have to take the ELM placement test?**

A. Yes. The MDTP tests are diagnostic tests while the ELM examination is a placement examination. However, the MDTP tests are rigorous, and a student who scores well on the MDTP Intermediate Algebra examination should do well on the ELM placement test.

Q. What should students do who are uncertain whether they are required to take the ELM placement test?

A. Admissions office or test office staff at the campus the student plans to attend will be able to answer questions about testing requirements and procedures.

Q. May students use calculators during the ELM placement test?

A. No. Beginning with the March 23, 2002, administration, calculators will no longer be allowed for the ELM placement test. The questions on the ELM do not require involved computation. Rather, the placement test includes problems that emphasize quantitative reasoning and problem solving.

Q. Why is math being tested?

A. With science and technology playing an increasingly important role in our society, all college-bound students must have an adequate grasp of mathematics. More and more undergraduate majors require some proficiency in math, and many require either statistics or calculus or both. These majors include agricultural science and management, business administration, economics, engineering, environmental sciences, medical physics, nursing, physical sciences, psychology, and premedical/predental programs.

Q. How does this placement test relate to the graduation requirements of a campus?

A. Basic mathematics provides the necessary background for the CSU general education quantitative reasoning requirement which consists of a course at the level of college algebra or higher. Such a course is required for graduation from the California State University. Successful completion of the ELM requirement is prerequisite to that course.

Q. How should a student prepare for the placement test?

A. Studies have shown that students who do not continue to use the math they have learned may have trouble recalling simple principles. Students with fewer than three years of college preparatory mathematics (who are not regularly admissible to the CSU) or those who have not used their math knowledge in some time will probably need additional work and review. An algebra review text or learning assistance center may be helpful in preparing for the placement test.

Q. Should a student who has completed at least three years of math in high school be ready for college-level math?

A. Yes. But students who have not had recent practice using their math skills will still benefit from a review. All students are encouraged to take mathematics in their senior year of high school.

Q. What happens if a student does not demonstrate proficiency on the ELM?

A. The CSU requires all students who do not demonstrate proficiency on the ELM placement test to be placed in appropriate remedial or developmental programs/activities during the first term of enrollment and each subsequent term until they demonstrate competence. The placement test is designed to help CSU campuses offer students the help they may need. A low score on the ELM means that a student probably needs extra help in order to do well in general education courses that require entry-level mathematics skills.

Q. Do students who receive a low score have to pay for extra help?

A. Probably not. Each campus offers different services for students who need help in basic mathematics. For example, some campuses offer prebaccalaureate courses in the mathematics department while others have established remedial education courses in the continuing education program. Some campuses offer tutorial programs using graduate students and peer tutors. Some campuses are developing modularized programs, structured to parallel topics covered by the ELM placement test; others are exploring programmed instruction, especially using interactive computers. Some campuses are developing modules that review specific topics that may be taken as directed study to prepare for courses in quantitative reasoning. A few campuses offer review courses for ELM preparation in continuing education courses. Finally, many campuses have well-developed learning assistance centers that are able to assist students.

Q. What happens if a student is out of the country on the first test date available?

A. Such a student must take the placement test at the next opportunity. It is to a student's advantage to take the placement test as soon as possible. All students **must** take the placement test before enrollment will be permitted.

Q. Does a student have to take the test at the campus the student plans to attend?

A. No. A student may take the test at whichever campus is most convenient. The resulting score will be sent to the appropriate campus.

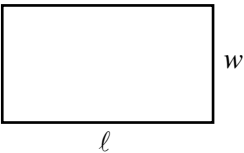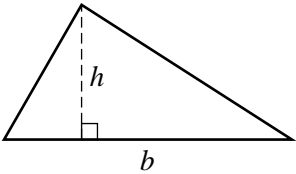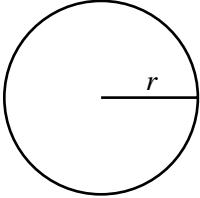**Q. How do students receive their placement test scores?**
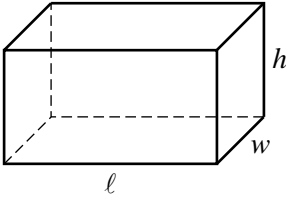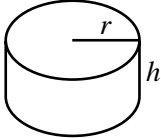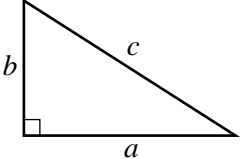
A. Test scores are mailed to the address provided by the student on the day of the test.

Q. How long are ELM testing materials and scores retained by ETS?

A. ETS retains answer sheets and test books for 18 months. Although answer sheets (not test books) are available for review at the ETS office in Oakland, they may not be returned to students. ELM scores are retained by ETS for the life of the program and are available from 1983 to the present.

Geometry Reference Formulas

Rectangle	$\text{Area} = \ell w$
	$\text{Perimeter} = 2\ell + 2w$
Triangle	$\text{Area} = \frac{1}{2} bh$
Circle	$\text{Area} = \pi r^2$
	$\text{Circumference} = 2\pi r$
Rectangular Solid	$\text{Volume} = \ell w h$
Right Circular Cylinder	$\text{Volume} = \pi r^2 h$
Pythagorean Theorem	$c^2 = a^2 + b^2$

Sample ELM Problems

Following are samples of the types of problems appearing on the ELM examination. This collection does not include every kind of question that might be asked, but the problems are typical in the way they examine the relevant skills and competencies that are listed in Table 1 on page 3. The answers appear on page 26.

Directions: Solve each of the following problems. You may use the blank space for scratchwork.

Notes: (1) Unless otherwise specified, the denominators of algebraic expressions appearing in these problems are assumed to be nonzero.
  (2) Figures that accompany problems are drawn as accurately as possible EXCEPT when it is stated that a figure is not drawn to scale.
  (3) The Geometry Reference Formulas appearing on the previous page will be printed inside the front cover of the ELM test book.
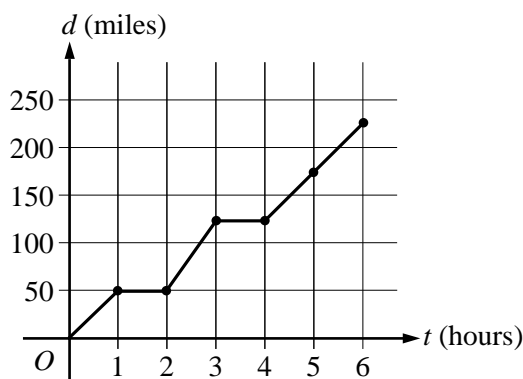
1. In the graph above, d represents the distance, in miles, that a motorist has traveled after t hours on the road. How many hours did it take the motorist to travel 200 miles?

  (A) 4.0   (B) 4.5   (C) 5.0   (D) 5.5   (E) 6.0

  Topic — Represent and understand data

2. $\left(3x^3 y\right)\left(-2x^2 y^3\right) =$
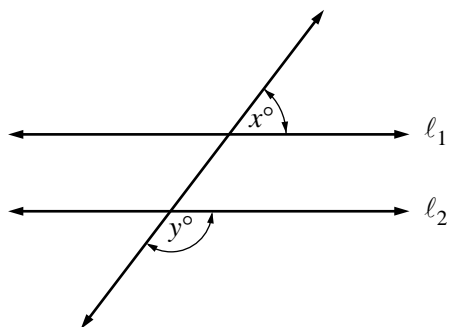
  (A) $-6x^5 y^4$ (B) $-6x^6 y^3$ (C) xy^{-2} (D) $x^6 y^3$ (E) $6x^5 y^3$

  Topic — Simplify algebraic expressions

3. A theater has 25 rows, each with 12 seats. At a certain performance there were, on average, 3 empty seats per row. What was the attendance at that performance?

    (A) 225   (B) 264   (C) 297   (D) 300   (E) 375

    Topic — Carry out basic arithmetic calculations

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4. In the figure above, ℓ_1 is parallel to ℓ_2 and $y = 127$. What is the value of x ?
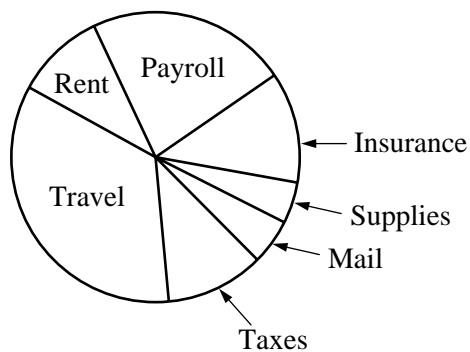
    (A) 37   (B) 45   (C) 53   (D) 60   (E) 63

    Topic — Determine angles in the plane

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5. If $b = 6$ and $h = 10$, then $\frac{1}{2} bh =$

    (A) 8   (B) 15   (C) 16   (D) 30   (E) 60

    Topic — Evaluate algebraic expressions

MONTHLY EXPENSES
OF COMPANY *X*

6. Which of the categories shown in the graph above accounts for approximately one-third of Company *X*'s expenses?

A) Insurance   (B) Payroll   (C) Rent   (D) Travel   (E) Taxes

Topic — Represent and understand data

7. If $4x - 5 = 18 - 7x$, then $x =$

(A) $-\dfrac{13}{3}$ (B) $\dfrac{13}{11}$ (C) 2   (D) $\dfrac{23}{11}$ (E) $\dfrac{23}{3}$

Topic — Solve linear equations

8. $(2x + 1)(x + 3) =$

(A) $3x + 4$ (B) $2x^2 + 3$ (C) $2x^2 + 7x + 3$ (D) $6x^2 + 5x + 1$ (E) $9x^3$

Topic — Perform polynomial arithmetic

9. A certain medicine is prescribed in an amount proportional to a patient's body weight. If a patient weighing 70 kilograms requires 210 milligrams of this medicine, then the amount of medicine required for a patient weighing 80 kilograms is

(A) 220 mg   (B) 230 mg   (C) 240 mg   (D) 250 mg   (E) 290 mg

Topic — Interpret and use ratio and proportion

I   II   III   IV
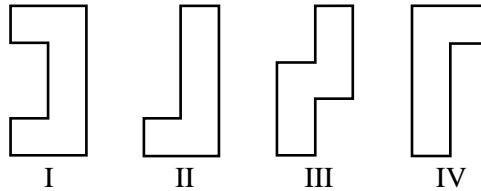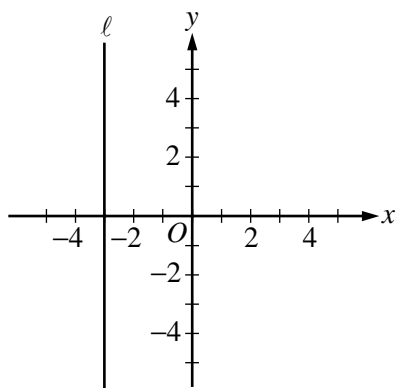
10. Which of the figures above are congruent?

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

Topic — Use properties of congruent geometric objects

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11. $\dfrac{5t^2 - 30t}{5t} =$

(A) $-29t$ (B) $t - 6$ (C) $t + 6$ (D) $5t^2 - 6$ (E) $5t^2 + 6$

Topic — Simplify algebraic expressions

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12. Which of the following is an equation of line ℓ in the figure above?

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

Topic — Graph linear functions

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13. $x^{-2} =$

(A) $\dfrac{1}{x^2}$ (B) $\sqrt{x}$ (C) $-x^2$ (D) $x^{\frac{1}{2}}$ (E) $x^{-\frac{1}{2}}$

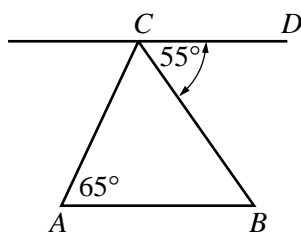*Topic —Simplify algebraic expressions*

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14. If $3x - d = c$, then $x =$

(A) $c + d - 3$ (B) $d + \dfrac{c}{3}$ (C) $\dfrac{d-c}{3}$ (D) $\dfrac{c-d}{3}$ (E) $\dfrac{c+d}{3}$

Topic — Solve linear equations

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15. One factor of $x^2 + 2x - 8$ is

(A) $x - 1$ (B) $x - 2$ (C) $x - 4$ (D) $x - 6$ (E) $x - 8$

Topic — Perform polynomial arithmetic

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16. In the figure above, *CD* is parallel to *AB*. What is the measure of $\angle ACB$?

    (A) 25°   (B) 35°   (C) 60°   (D) 120°   (E) 125°

    Topic — Determine angles in the plane

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17. If the point $(2, 4)$ is on the line $y = 6x + b$, then $b =$

    (A) −22   (B) −8   (C) 12   (D) 16   (E) 26

    Topic — Plot points on the graph of a function

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18. An apple falling from a tree is *h* feet above the ground *t* seconds after it begins to fall, where $h = 64 - 16t^2$. After how many seconds will the apple hit the ground ($h = 0$) ?

    (A) 1   (B) 2   (C) 4   (D) 8   (E) 48

    Topic — Solve problems modeled by quadratic equations
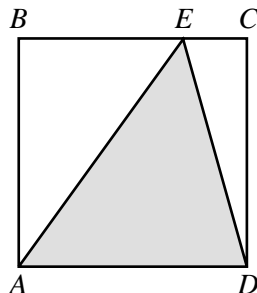
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19. If $\sqrt{n - 1} = 4$, then $n =$

    (A) 3   (B) 9   (C) 15   (D) 17   (E) 25

    Topic — Square roots

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20. If $\begin{cases} 2x + 3y = 6 \\ x = -2y + 5, \end{cases}$ then $y =$

(A) −4   (B) −2   (C) −1   (D) 2   (E) 4

Topic — Solve systems of linear equations

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21. The area of square *ABCD* in the figure above is 64. What is the area of the shaded triangle *AED* ?

(A) 16   (B) 24   (C) 28   (D) 30   (E) 32

Topic — Find area

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22. The operating budget of the Western Robotics Company was $300 million last year. If the operating budget this year is 12 percent less than last year, what is this year's operating budget, in millions of dollars?

(A) 36   (B) 264   (C) 274   (D) 288   (E) 336

Topic — Use percent

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23. In the coordinate plane, which of the following is the midpoint of the line segment with endpoints $(2, 5)$ and $(6, 1)$?

(A) $(8, 6)$ (B) $(4, 3)$ (C) $(4, 4)$ (D) $\left(\dfrac{7}{2}, \dfrac{7}{2}\right)$ (E) $\left(\dfrac{3}{2}, \dfrac{5}{2}\right)$
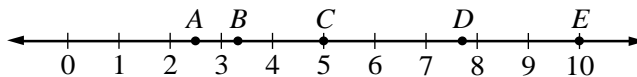
Topic — Find midpoint of a line segment

Player	Weight (in pounds)
R	270
S	230
T	240
U	?

24. If the average weight of the four players listed in the table above is 250 pounds, what is the weight, in pounds, of Player U ?
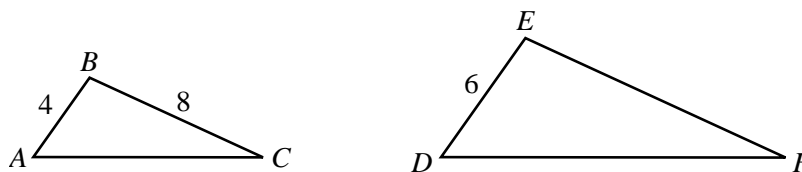
(A) 220   (B) 230   (C) 240   (D) 250   (E) 260

Topic — Calculate the arithmetic mean

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25. Which point on the number line above could represent $\sqrt{10}$?

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

Topic —Estimate square roots

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26. Triangles *ABC* and *DEF* in the figure above are similar. What is the length of *EF* ?

   (A) 4   (B) 6   (C) 8   (D) 12   (E) 16

   Topic — Use properties of similar geometric objects

27. The ratio of the number of boys to the number of girls in an algebra class is 4 to 5. If there are 45 students in the class, how many are girls?

   (A) 11   (B) 20   (C) 25   (D) 36   (E) 41

   Topic — Interpret and use ratio and proportion

ENROLLMENT AT CENTRAL COLLEGE

Freshmen	1,816
Sophomores	1,473
Juniors	1,431
Seniors	1,298

28. According to the table above, which of the following best approximates the total enrollment at Central College?

   (A) $1,800 + 1,400 + 1,400 + 1,200$
   (B) $1,800 + 1,400 + 1,400 + 1,300$
   (C) $1,800 + 1,500 + 1,400 + 1,300$
   (D) $1,900 + 1,500 + 1,400 + 1,300$
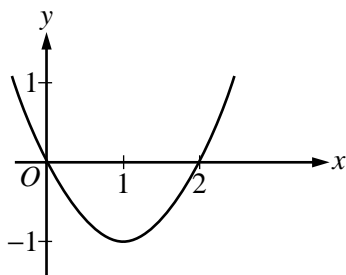   (E) $1,900 + 1,500 + 1,500 + 1,300$

   Topic —Use estimation appropriately
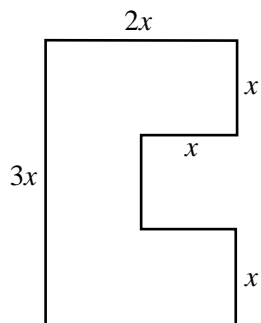
29. What is the perimeter of the figure above if all intersecting line segments meet at right angles?

(A) $6x$　(B) $8x$　(C) $10x$　(D) $11x$　(E) $12x$

Topic — Find perimeter

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30. The figure above shows the graph of $y = f(x)$. What are all values of x for which $f(x) > 0$?

(A) $x < 0$　(B) $x > 1$　(C) $x > 2$　(D) $0 < x < 2$　(E) $x < 0$ or $x > 2$

Topic — Relate basic information about a function to features of its graph
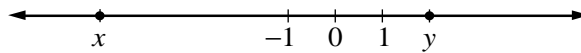
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31. The inequality $-3x < 5$ is equivalent to

(A) $x < -15$　(B) $x < -\dfrac{5}{3}$　(C) $x > -15$　(D) $x > -\dfrac{5}{3}$　(E) $x > -\dfrac{3}{5}$

Topic — Solve linear inequalities

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32. Marshall is making corn bread. His recipe calls for $3\frac{1}{2}$ cups of cornmeal, but he wants to make only half the amount given in the recipe. How many cups of cornmeal should he use?

(A) $1\frac{1}{4}$ (B) $1\frac{1}{2}$ (C) $1\frac{3}{4}$ (D) 5   (E) 7

Topic — Solve problems involving fractions

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33. Which of the following must be true about the numbers x and y graphed on the number line above?
    I. $x + y > 0$
    II. $y - x > 0$
    III. $xy > 0$

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

Topic — Evaluate the reasonableness of a solution

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34. Which of the following numbers is between 3.74 and $3\frac{4}{5}$?

(A) $3\frac{9}{10}$ (B) 3.72   (C) 3.82   (D) $3\frac{1}{2}$ (E) $3\frac{3}{4}$

Topic — Compare and order rational numbers

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35. The sale price of Kathy's new briefcase was reduced 30% from the original price of $80. What was the sale price of the briefcase?
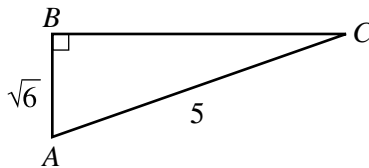
(A) $30   (B) $40   (C) $50   (D) $56   (E) $104

Topic — Use percent

0.12   0.018   0.04   0.004

36. In which of the following are the four decimals above listed in order from greatest to least?

   (A) 0.12   0.018   0.04   0.004
   (B) 0.12   0.04   0.018   0.004
   (C) 0.018   0.12   0.004   0.04
   (D) 0.018   0.004   0.12   0.04
   (E) 0.04   0.004   0.12   0.018

Topic — Compare and order rational numbers

---

37. In right triangle ABC above, $BC =$

   (A) $5 - \sqrt{6}$ (B) $\sqrt{19}$ (C) $\sqrt{31}$ (D) $5 + \sqrt{6}$ (E) 4

Topic — Use the Pythagorean Theorem

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38. $\dfrac{a}{b} + \dfrac{b}{a} =$

   (A) 1   (B) $\dfrac{ab}{a+b}$ (C) $\dfrac{a+b}{ab}$ (D) $a^2 + b^2$ (E) $\dfrac{a^2 + b^2}{ab}$

Topic — Perform arithmetic operations involving rational expressions

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39. What is the slope of the line through the points $(2, 1)$ and $(4, 2)$?

(A) $-\dfrac{1}{2}$ (B) $-\dfrac{1}{4}$ (C) $\dfrac{1}{4}$ (D) $\dfrac{1}{2}$ (E) 2

Topic — Find and use slopes and intercepts of lines

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40. This year José earned 3 times as much money as he earned last year. If José earned T dollars this year and he earned L dollars last year, which of the following equations represents the relationship between T and L ?

(A) $3L = T$ (B) $\dfrac{L}{3} = T$ (C) $T \times L = 3$ (D) $\dfrac{L}{3} = \dfrac{T}{3}$ (E) $\dfrac{L}{3} = \dfrac{3}{T}$

Topic — Express relationships among quantities

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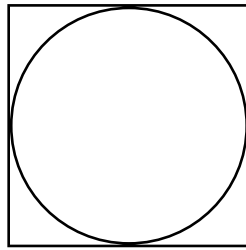
41. If the area of the square shown above is 36, what is the area of the inscribed circle?

(A) 6   (B) 36   (C) 6π (D) 9π (E) 36π

Topic — Find area

HISTORY TEST SCORES

Test 1	82
Test 2	71
Test 3	93
Test 4	88
Test 5	86

42. Dan's scores on 5 history tests are given in the table above. What is the median of Dan's scores?

(A) 82   (B) 84   (C) 86   (D) 88   (E) 93

Topic — Calculate the median

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43. $\sqrt{24}$ is a number between

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

Topic — Estimate square roots

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44. A line ℓ with slope 2 passes through the origin. Which of the following is a point on line ℓ ?

(A) (2, 4)   (B) (2, 2)   (C) (2, 1)   (D) (2, −1)   (E) (2, −4)

Topic — Find and use slopes and intercepts of lines

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45. Maria worked in a library. She was paid at the rate of $6.00 per hour. If she worked from 10:30 A.M. to 4:45 P.M. on Tuesday, how much money did she earn?

(A) $30.00   (B) $33.00   (C) $34.50   (D) $36.00   (E) $37.50

Topic — Solve problems involving fractions and decimals

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46. A stack of three cubes of the same size has a volume of 24 cubic inches. What is the length, in inches, of an edge of one of the cubes?

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

Topic — Find volume

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47. An investment company advertised that last year its clients, on average, made a profit of 9%. Which of the following claims can legitimately be made, based on that information?

(A) All of their clients made a profit of at least 9% last year.
(B) At least one of their clients made a profit of at least 9% last year.
(C) Some of their clients will make a profit of at least 9% this year.
(D) All of their clients will make a profit of at least 9% this year.
(E) If a person becomes one of their clients, that person will make a profit of at least 9% each year.

Topic — Distinguish between reasonable and unreasonable claims

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WEATHER BALLOON TEMPERATURES

Height	Temperature
1,000 ft.	23°
2,000 ft.	20°
3,000 ft.	17°

48. A weather balloon is released and as it rises in the air it records the temperature, in degrees Celsius, as shown in the table above. If the temperature continues to decrease at a constant rate, the temperature at 5,500 feet will be

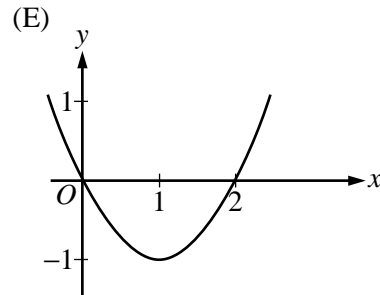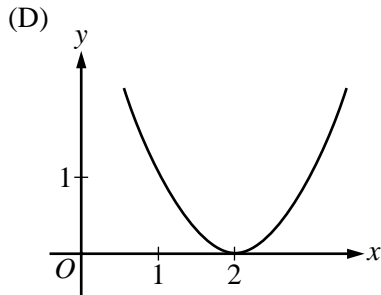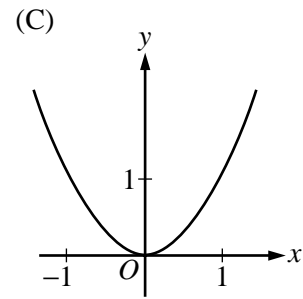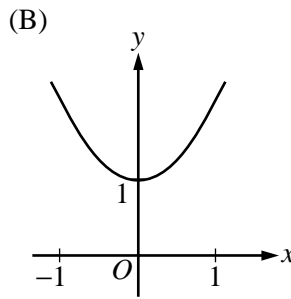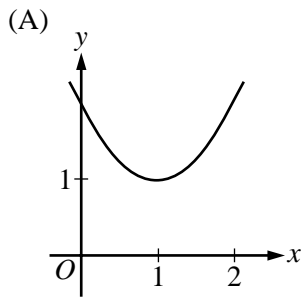(A) 12.5°   (B) 11°   (C) 9.5°   (D) 8°   (E) 6.5°

Topic — Use constant rates

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49. How many dollars will x pens cost if 5 such pens cost y dollars?

(A) $\dfrac{xy}{5}$ (B) $\dfrac{5}{xy}$ (C) $5xy$ (D) $\dfrac{y}{5x}$ (E) $\dfrac{x}{5y}$

Topic — Interpret and use ratio and proportion

50. Which of the following is the graph of $y = x^2 + 1$?

(A)

(B)

(C)

(D)

(E)

Topic — Graph quadratic functions

Answer Key to Sample Problems

1. D	6. D	11. B	16. C	21. E	26. D	31. D	36. B	41. D	46. A
2. A	7. D	12. B	17. B	22. B	27. C	32. C	37. B	42. C	47. B
3. A	8. C	13. A	18. B	23. B	28. C	33. B	38. E	43. E	48. C
4. C	9. C	14. E	19. D	24. E	29. E	34. E	39. D	44. A	49. A
5. D	10. E	15. B	20. E	25. B	30. E	35. D	40. A	45. E	50. B

The CSU/UC Mathematics Diagnostic Testing Project

Since 1978 the California State University and the University of California have funded jointly the development of a series of mathematics diagnostic tests. The group writing the tests includes high school, university, and community college faculty. Tests are available free of charge to test skills in pre-algebra, elementary and intermediate algebra, and precalculus. Scoring and interpretation services are provided by regional MDTP service sites. Scores are reported only to teachers in order to ensure that the tests are used solely for diagnosis and improvement of classroom teaching.

More information about this program can be obtained by contacting:

Tom Walters
Mathematics Diagnostic Testing Project
Mailbox 951555
Los Angeles, CA 90095-1555
Phone: (310) 206-8360
Fax: (310) 206-6673
E-mail: twalters@math.ucla.edu

FOR FURTHER INFORMATION

Additional questions concerning CSU admission requirement or placement in mathematics should be directed to Dr. Nancy C. Sprotte or Mr. Allison G. Jones, Office of Student Academic Support, 401 Golden Shore, Sixth Floor, Long Beach, CA 90802-4210. Telephone: (562) 951-4726.