CLEP® Calculus: At a Glance

Description of the Examination

The Calculus examination covers skills and concepts that are usually taught in a one-semester college course in calculus. The content of each examination is approximately 60 percent limits and differential calculus and 40 percent integral calculus. Algebraic, trigonometric, exponential, logarithmic and general functions are included. The exam is primarily concerned with an intuitive understanding of calculus and experience with its methods and applications. Knowledge of preparatory mathematics, including algebra, geometry, trigonometry and analytic geometry, is assumed.

The examination contains 44 questions, in two sections, to be answered in approximately 90 minutes. Any time candidates spend on tutorials and providing personal information is in addition to the actual testing time.

• Section 1: 27 questions, approximately 50 minutes. No calculator is allowed for this section.

• Section 2: 17 questions, approximately 40 minutes. The use of an **online graphing calculator (non-CAS)** is allowed for this section. A graphing calculator is integrated into the exam software, and it is available to students during Section 2 of the exam. Only some of the questions will require the use of the calculator.

The graphing calculator, together with a brief tutorial, is available to students as a free download for a 30-day trial period. Students are expected to download the calculator and become familiar with its functionality prior to taking the exam. For more information about the practice version of the graphing calculator, visit the Calculus exam description on the CLEP® website, **www.collegeboard.com/clep**.

Knowledge and Skills Required

Questions on the exam require candidates to demonstrate the following abilities:

- Solving routine problems involving the techniques of calculus (approximately 50 percent of the exam)
- Solving nonroutine problems involving an understanding of the concepts and applications of calculus (approximately 50 percent of the exam)

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

10% Limits

- Statement of properties, e.g., limit of a constant, sum, product or quotient
- Limit calculations, including limits involving infinity, e.g.,

$$\lim_{x\to 0}\frac{\sin x}{x}=1,\ \lim_{x\to 0}\frac{1}{x}\text{ is nonexistent, and }\lim_{x\to\infty}\frac{\sin x}{x}=0$$

- Continuity

50% Differential Calculus

The Derivative

• Definitions of the derivative

$$\text{e.g., } f'(a)=\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$$

$$\text{and } f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

- Derivatives of elementary functions
- Derivatives of sums, products and quotients (including tan x and cot x)
- Derivative of a composite function (chain rule), e.g., $\sin(ax+b)$, ae^{kx}, $\ln(kx)$
- Implicit differentiation
- Derivative of the inverse of a function (including arcsin x and arctan x)
- Higher order derivatives
- Corresponding characteristics of graphs of f, f' and f''
- Statement of the Mean Value Theorem; applications and graphical illustrations
- Relation between differentiability and continuity
- Use of L'Hôpital's Rule (quotient and indeterminate forms)

Applications of the Derivative

- Slope of a curve at a point
- Tangent lines and linear approximation
- Curve sketching: increasing and decreasing functions; relative and absolute maximum and minimum points; concavity; points of inflection
- Extreme value problems
- Velocity and acceleration of a particle moving along a line
- Average and instantaneous rates of change
- Related rates of change

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40% Integral Calculus

Antiderivatives and Techniques of Integration

- Concept of antiderivatives
- Basic integration formulas
- Integration by substitution (use of identities, change of variable)

Applications of Antiderivatives

- Distance and velocity from acceleration with initial conditions
- Solutions of $y' = ky$ and applications to growth and decay

The Definite Integral

- Definition of the definite integral as the limit of a sequence of Riemann sums and approximations of the definite integral using areas of rectangles
- Properties of the definite integral
- The Fundamental Theorem:

$$\frac{d}{dx}\int_a^x f(t)\,dt = f(x) \text{ and } \int_a^b F'(x)\,dx = F(b) - F(a)$$

Applications of the Definite Integral

- Average value of a function on an interval
- Area, including area between curves
- Other (e.g., accumulated change from a rate of change)

Study Resources

To prepare for the Calculus exam, you should study the contents of at least one introductory college-level calculus textbook, which you can find for sale online and in most college bookstores. You would do well to consult several textbooks, because the approaches to certain topics may vary. When selecting a textbook, check the table of contents against the Knowledge and Skills Required for this exam.

A recent survey conducted by CLEP found that the following textbooks are among those used by college faculty who teach the equivalent course. Most of these have companion websites with practice test questions and other study resources. HINT: When selecting a textbook, check the table of contents against the Knowledge and Skills Required for this test.

Anton et al., *Calculus: Early Transcendentals Single Variable* (Wiley)
Armstrong and Davis, *Brief Calculus* (Prentice Hall)
Bear, *Understanding Calculus* (Wiley-IEEE)
Best et al., *Calculus: Concepts and Calculators* (Venture)
Cohen and Henle, *Calculus: The Language of Change* (Jones & Bartlett)
Hallett et al., *Applied Calculus* (Wiley)
Hass et al., *University Calculus, Part One* (Addison-Wesley)
Krantz, *Calculus Demystified: A Self-Teaching Guide* (McGraw-Hill)
Larson et al., *Calculus I: Early Transcendental Functions* (Brooks/Cole)
Neill, *Teach Yourself Calculus* (McGraw-Hill)
Rogawski, *Calculus* (W. H. Freeman)
Salas et al., *Calculus: One Variable* (Wiley)
Schmidt, *Life of Fred: Calculus* (Polka Dot)
Smith and Minton, *Calculus, Single Variable: Early Transcendental Functions* (McGraw-Hill)
Stewart, *Single Variable Calculus* (Brooks/Cole)

In addition, the following resources, compiled by the CLEP test development committee and staff members, may help you study for your exam. However, none of these sources are designed specifically to provide preparation for a CLEP exam. The College Board has no control over their content and cannot vouch for accuracy.

http://www.sosmath.com/calculus/calculus.html (website or CD)

http://mathforum.org/mathtools/sitemap2/c/ (Math Forum Math Tools, Drexel U.)

http://mathworld.wolfram.com/topics/CalculusandAnalysis.html (Wolfram MathWorld)

http://www.jtaylor1142001.net/calcjat/Contents/CalcCont.html (Aid for Calculus)

http://oregonstate.edu/instruct/mth251/cq/index.html (Oregon State's Calculus course online)

http://www.montereyinstitute.org/nroc/nrocdemos.html (National Repository of Online Courses)

http://ocw.mit.edu/OcwWeb/web/courses/courses/index.htm#Mathematics (MIT)

http://math.spsu.edu/Dillon/NSF.htm (NSF-funded online course)

Visit **www.collegeboard.com/clepprep** for additional calculus resources. You can also find suggestions for exam preparation in Chapter IV of the *CLEP Official Study Guide*. In addition, many college faculty post their course materials on their schools' websites.

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. For more sample questions and information about the test, see the *CLEP Official Study Guide*.

1. What is $\lim_{x \to 1} \frac{1-x^2}{x^4-x}$?

(A) -2

(B) $-\frac{2}{3}$

(C) $\frac{2}{3}$

(D) 1

(E) The limit does not exist.

2. What is the slope of the line tangent to the graph of the function $f(x) = \ln(\sin^2 x + 3)$ at the point where $x = \frac{\pi}{3}$?

(A) $\frac{1}{15}$

(B) $\frac{\sqrt{3}}{15}$

(C) $\frac{2\sqrt{3}}{15}$

(D) $\frac{4}{15}$

(E) $\frac{2}{3}$

The following question is an example of a question that you might find in Section 2 of the exam; the use of a graphing calculator would be appropriate.

3. Let $f(x) = \sqrt{2x+1}$. If g is the inverse function of f, then $g'(3) =$

(A) $\frac{1}{2\sqrt{7}}$

(B) $\frac{1}{\sqrt{7}}$

(C) $\frac{1}{3}$

(D) $\sqrt{7}$

(E) 3

4. Oil is poured on a flat surface, and it spreads out forming a circle. The area of this circle is increasing at a constant rate of 5 cm^2/s. At what rate, in cm/s, is the radius of the circle increasing when the radius is 5 cm?

(A) $\frac{1}{2\pi}$

(B) $\frac{1}{\pi}$

(C) 1

(D) π

(E) 2π

5. Let f be a continuous function on the closed interval $[0,3]$, and let c be a point in $[0,3]$ such that $f(c)=2$ is a maximum value of f on $[0,3]$. Which of the following CANNOT be true?

(A) f is increasing on $[0,3]$

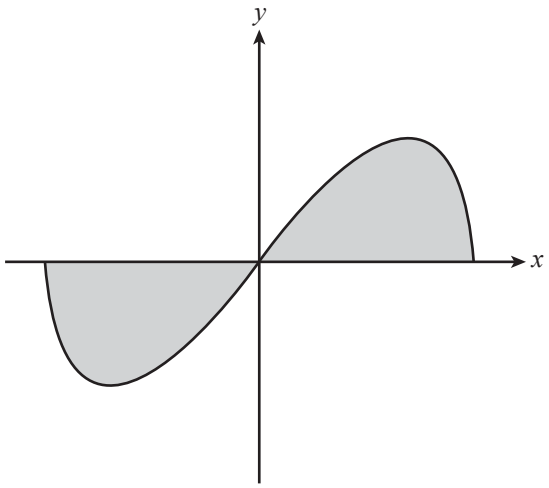
(B) f is decreasing on $[0,3]$

(C) $f(x)=x(3-x)-\frac{1}{4}$

(D) $\int_0^3 f(x)\,dx=7$

(E) $\int_0^3 f(x)\,dx=5$

Type your answer in the box below.



6. What is the area of the shaded region in the figure above that is bounded by the x-axis and the curve with the equation $y=x\sqrt{1-x^2}$?

Credit Recommendations

The American Council on Education has recommended that colleges grant 3 credits for a score of 50, which is equivalent to a course grade of C, on the CLEP Calculus exam. Each college, however, is responsible for setting its own policy. For candidates with satisfactory scores on the Calculus examination, colleges may grant credit toward fulfillment of a distribution requirement, or for a particular course that matches the exam in content. Check with your school to find out the score it requires for granting credit, the number of credit hours granted, and the course that can be bypassed with a passing score.

Answers to Sample Questions:
(1) B; (2) C; (3) E; (4) A; (5) D; (6) 2/3.