

The new, enhanced version of

powered by CourseCompass™ and MathXL®
MyMathLab

for The **THOMAS' CALCULUS Series:**

THE ULTIMATE HOMEWORK AND TUTORIAL
 SOLUTION FOR TODAY'S STUDENTS

Today's students rely on the exercises to help them make the leap from single to multi-variable calculus. The exercises in the newly enhanced MyMathLab™ for the *Thomas' Calculus* Series gradually increase in difficulty and help today's students learn to generalize and apply important mathematical concepts.

MyMathLab™ courses include a full eBook with a variety of multimedia resources available directly from selected examples and exercises on the page.

George B. Thomas, Jr., Maurice D. Weir, Joel Hass, Frank R. Giordano
Thomas' Calculus Media Upgrade, Eleventh Edition

Chapter 14: Partial Derivatives: 14.8 Lagrange Multipliers

1046 Chapter 14: Partial Derivatives

These are the points where ∇f is normal to C , as we saw in Theorem 12. But ∇g_1 and ∇g_2 are also normal to C at these points because C lies in the surfaces $g_1 = 0$ and $g_2 = 0$. Therefore, ∇f lies in the plane determined by ∇g_1 and ∇g_2 , which means that $\nabla f = \lambda \nabla g_1 + \mu \nabla g_2$ for some λ and μ . Since the points we seek also lie in both surfaces, their coordinates must satisfy the equations $g_1(x, y, z) = 0$ and $g_2(x, y, z) = 0$, which are the remaining requirements in Equations (2).

EXAMPLE 5 Finding Extremes of Distance on an Ellipse
 The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse (Figure 14.57). Find the points on the ellipse that lie closest to and farthest from the origin.

Solution We find the extreme values of

$$f(x, y, z) = x^2 + y^2 + z^2$$

(the square of the distance from (x, y, z) to the origin) subject to the constraints

$$g_1(x, y, z) = x^2 + y^2 - 1 = 0 \quad (3)$$

$$g_2(x, y, z) = x + y + z - 1 = 0. \quad (4)$$

The gradient equation in Equations (2) then gives

$$\nabla f = \lambda \nabla g_1 + \mu \nabla g_2$$

$$2x\mathbf{i} + 2y\mathbf{j} + 2z\mathbf{k} = \lambda(2x\mathbf{i} + 2y\mathbf{j}) + \mu(\mathbf{i} + \mathbf{j} + \mathbf{k})$$

$$2x\mathbf{i} + 2y\mathbf{j} + 2z\mathbf{k} = (2\lambda x + \mu)\mathbf{i} + (2\lambda y + \mu)\mathbf{j} + \mu\mathbf{k}$$

or

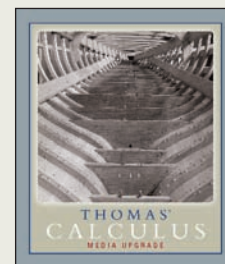
$$2x = 2\lambda x + \mu, \quad 2y = 2\lambda y + \mu, \quad 2z = \mu. \quad (5)$$

FIGURE 14.57 On the ellipse where the plane and cylinder meet, what are the points closest to and farthest from the origin? (Example 5)

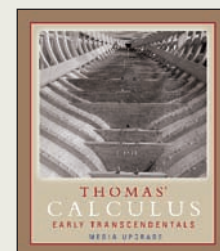
Copyright © 2008 Pearson Education, Inc., publishing as Pearson Addison-Wesley | Legal Terms

MyMathLab™ provides a rich and flexible set of course materials, featuring free-response exercises that are algorithmically generated for unlimited practice and mastery. Instructors can use the homework and test managers to select and assign online exercises correlated directly to the textbook, and they can import TestGen® tests into MyMathLab™ for added flexibility.

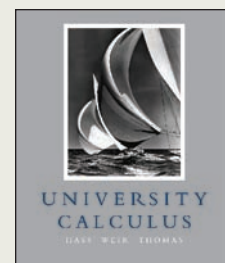
The Thomas' Calculus Series



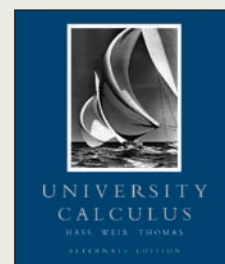
Thomas' Calculus, Media Upgrade, Eleventh Edition
 0-321-48987-X • 978-0-321-48987-6



*Thomas' Calculus, Early Transcendentals
 Media Upgrade*, Eleventh Edition
 0-321-49575-6 • 978-0-321-49575-4



University Calculus
 0-321-35014-6 • 978-0-321-35014-5

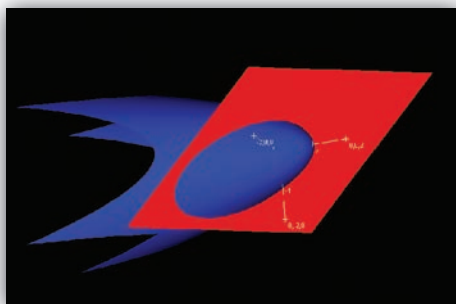


University Calculus: Alternate Edition
 0-321-47196-2 • 978-0-321-47196-3

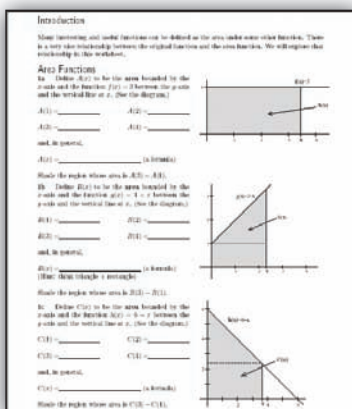
powered by CourseCompass™ and MathXL®

MyMathLab

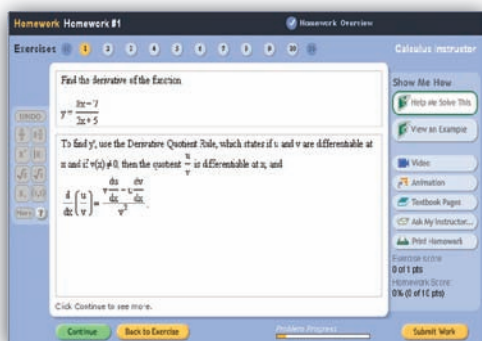
Enhancements



New Java™ Applets allow students to interact with three-dimensional visualizations of multivariable calculus problems. These exploratory applets help students visualize and experiment with abstract concepts. The pedagogical links tie the applets directly to the content of the book and are available for every section of the multivariable chapters.



Group Projects are new applied and conceptual problems that can be used in the classroom or assigned to students working in teams. As students work through these projects, they learn how to generalize essential concepts by using calculus to creatively solve challenging, real-world problems.

MathXL

New MathXL® Exercises expand on the already impressive array of problem sets in the text, giving students greater opportunities to practice solving problems. The new MathXL® exercises include:

- **Precalculus Review Exercises** to help students strengthen their algebra and trigonometry skills.
- **Routine, Mid-level, and Advanced Exercises** to help build students' mathematical intuition and conceptual understanding.

Also available
for Mac® users:

WebAssign.

WebAssign® is an online homework, quizzing, and testing management system. As a hosted application service, WebAssign® allows professors to assign algorithmically generated questions to their students, and includes a gradebook that automatically records student answers. WebAssign® works with personal computers using any recent operating system and browser.

WeBWoRk

WeBWoRk® is an open-source Internet-based method for delivering homework problems to students online. It automatically grades homework and provides immediate feedback, allowing students to correct mistakes while they are still working on the problem. WeBWoRk® can be accessed over the Internet using any recent operating system and browser. The WeBWoRk® server runs on Unix or other LAMP operating systems and can be freely obtained at www.openwebwork.org.

PEARSON
Addison
Wesley

75 ARLINGTON STREET, SUITE 300
BOSTON, MA 02116

www.aw-bc.com

Visit www.aw-bc.com/demo/thomas to view an interactive demo of the *Thomas' Calculus Series* and *MyMathLab™*.

For more information, visit us at www.aw-bc.com/math or contact your local Addison-Wesley sales representative at www.aw-bc.com/replocator