

Calculus Optimization Problems/Related Rates Problems Solutions

- 1) A farmer has 400 yards of fencing and wishes to fence three sides of a rectangular field (the fourth side is along an existing stone wall, and needs no additional fencing). Find the dimensions of the rectangular field of largest area that can be fenced.

$$2x + y = 400 \Rightarrow y = 400 - 2x$$

$$A(x) = x(400 - 2x) = 400x - 2x^2$$

$$A'(x) = 400 - 4x \quad 400 - 4x = 0 \Rightarrow x = 100$$

$$A''(x) = -4$$

By the 2nd derivative test, the dimensions would be 100 yd by 200 yd.

- 2) A metal box (without a top) is to be constructed from a square sheet of metal that is 20 cm on a side by cutting square pieces of the same size from the corners of the sheet and then folding up the sides. Find the dimensions of the box with the largest volume that can be constructed in this manner.

$$V(x) = x(20 - 2x)(20 - 2x) = 400x - 80x^2 + 4x^3$$

$$V'(x) = 400 - 160x + 12x^2$$

$$400 - 160x + 12x^2 = 0 \Rightarrow 4(100 - 40x + 3x^2) = 0 \Rightarrow 4(3x - 10)(x - 10) \Rightarrow x = \frac{10}{3}, 10$$

$$V''(x) = -160 + 24x \quad V''\left(\frac{10}{3}\right) = -160 + 80 < 0 \quad V''(10) = -160 + 240 > 0$$

By the 2nd derivative test, the dimensions would be $\frac{10}{3}$ cm by $\frac{40}{3}$ cm by $\frac{40}{3}$ cm

- 3) A rectangular field adjacent to a river is to be enclosed. Fencing along the river costs \$5 per meter, and the fencing for the other sides costs \$3 per meter. The area of the field is to be 1200 square meters. Find the dimensions of the field that is the least expensive to enclose.

Call the length of fence along the river x , and the length perpendicular to the river y .

$$C(x) = 5x + 3(2y + x) \quad xy = 1200 \Rightarrow y = \frac{1200}{x} \Rightarrow C(x) = 8x + \frac{7200}{x}$$

$$C'(x) = 8 - \frac{7200}{x^2} \quad 8 - \frac{7200}{x^2} = 0 \Rightarrow 8x^2 = 7200 \Rightarrow x^2 = 900 \Rightarrow x = 30$$

$$C''(x) = \frac{14400}{x^3} \quad C''(30) = \frac{14400}{30^3} > 0$$

By the 2nd derivative test, a field that is 30 m along the river by 40 m perpendicular to the river would be least expensive.

- 4) A 4-meter length of stiff wire is cut in two pieces. One piece is bent into the shape of a square and the other into a rectangle whose length is 3 times its width. Let x be the length of the side of the square.

a) Find a formula $A(x)$, the sum of the areas of the square and rectangle, in terms of the variable x .

The length of wire left for the rectangle is $4 - 4x$. In the rectangle, $l = 3w$. $4 - 4x = 2(3w) + 2w$,

$$\text{so } w = \frac{4 - 4x}{8} = \frac{1 - x}{2} \Rightarrow l = \frac{3 - 3x}{2} \quad A(x) = x^2 + \left(\frac{3 - 3x}{2}\right)\left(\frac{1 - x}{2}\right)$$

Calculus Optimization Problems Solutions

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Calculus Optimization Problems Solutions:

Calculus Optimization Problems Solutions: Bestsellers in 2023 The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous engrossing novels captivating the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the captivating narratives that have charmed audiences this year. The Must-Read : Colleen Hoovers "It Ends with Us" This poignant tale of love, loss, and resilience has gripped readers with its raw and emotional exploration of domestic abuse. Hoover masterfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can prevail. Calculus Optimization Problems Solutions : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids captivating storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Calculus Optimization Problems Solutions : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These popular novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papan, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a exceptional and suspenseful novel that will keep you guessing until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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