

Question #1
Calculus Bowl 2000

Find an equation of each normal line to the graph of $y = \frac{2x}{x-1}$ and parallel to the line $2x - y + 1 = 0$.
(Use slope-intercept form.)

Question #2
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Let $P(x) = x^4 + ax^3 + bx^2 + cx + d$. The graph of $y = P(x)$ is symmetric with respect to the y-axis, has a relative maximum at $(0, 1)$ and has an absolute minimum at $(q, -3)$.
Determine $a + b + c + d$.

Question #3
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A farmer estimates that if he digs his potatoes now, he will have 160 bushels worth \$2 a bushel. If he waits, the crop will increase by 40 bushels a week, but the selling price will drop 20 cents per bushel per week and picking costs will go up 5 cents per bushel per week. When should he dig his potatoes to get the most income (how long from now)?

Question #4
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A light is on top of a pole h feet high. A ball is dropped from a point at the same height as the light but k feet horizontally away from it. How fast is the shadow of the ball moving along the ground $\frac{1}{2}$ second later? Assume that the ball falls a distance $s = 16t^2$ feet in t seconds.

Question #5
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The number y of bacteria in a culture at time t is given approximately by $y = 1000(25 + te^{\frac{-t}{20}})$ for $0 \leq t \leq 100$. Find the smallest number of bacteria in the culture during the interval.

Question #6
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There is a region formed by the parabola $16y = 5x^2 + 16$ and the lines $y = 0$, $x = 0$, $y = 6$, and $x = 5$. Find the area of this region.

Question #7
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Find $\frac{dr}{d\theta}$ in simplest form if $r = \frac{\sqrt{1 - \cos 2\theta}}{\tan \theta}$, if $0 \leq \theta \leq \frac{\pi}{4}$.

Question #8
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If $y = e^{-x} + \sin x$, find $\frac{d^{100}y}{dx^{100}}$

Question #9

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Let R be the region in the first quadrant bounded by the x -axis and the curve $y = kx - x^2$, where $k > 0$. Find the value of k for which the volume when the region R is revolved about the x -axis is the same as the volume when the region R is revolved about the y -axis.

Question #10

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Consider the function $f(x) = x^{\frac{4}{3}} + 4x^{\frac{1}{3}}$ on $[-8, 8]$. Find the coordinates of all points at which the tangent to the curve is a vertical line.

Question #11

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Find the tangent (in the form $ax + by = c$) to the curve $x^2 + y^2 - 6x + 4y - 12 = 0$ at the point on the curve in the 4th quadrant where $x = 7$.

Question #12

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A particle is moving on a line in such a fashion that at time t its acceleration is $6t$ inches per second per second. When $t = 1$, the particle's distance from the origin is 10 inches; and when $t = 2$, the distance is 80 inches. Find the velocity with which the particle is moving when $t = 3$.

Question #13

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Find the interval of convergence for the series $\sum_{n=1}^{\infty} \frac{(x-2)^n}{n(3^n)}$

Question #14

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What is the work (in ft-lbs) done by a force (in lbs), propelling a particle along the x -axis from $x = 1$ to $x = 4$ (in ft), if $F = \frac{1}{\sqrt{x}}$?

Question #15

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Differentiate $y = x^x$.