

CALCULUS TEAM

QUESTION # 1

JANUARY 8, 1994

Find the slope of the tangent line to the graph  
 $y = \cos \pi x \sin^2 \pi x$  at the point  $(1/2, 0)$ .

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QUESTION # 2

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If  $4e^{(x)(x)(y)} - 6x + 2y = 0$ , find  $\lim_{x \rightarrow 0} (dy/dx)$ .

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QUESTION # 3

JANUARY 8, 1994

$$A = \lim_{x \rightarrow 0^-} \frac{|x|}{2x}$$

$$B = \lim_{x \rightarrow 0} \frac{x^3 + x^2 - 20x}{x^3 - x^2 - 2x}$$

$$C = \lim_{x \rightarrow 0} \frac{-\tan x}{x \sec x}$$

$$D = \lim_{x \rightarrow 0^+} 2 \left[ 2x + 1 \right]$$

Find  $(A - 2B)/CD$ .

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QUESTION # 4

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Find  $dy/dx$  if  $f(x) = \ln \left( \frac{2e^x}{2e^x - 1} \right)$ .

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QUESTION # 5

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A river boat company offers a Fourth of July excursion to a fraternal organization with the understanding that there will be at least 400 passengers. The price of each ticket will be \$12.00, and the company agrees to refund \$0.20 to every passenger for each 10 passengers in excess of 400. After determining a price function  $p(x)$ , find the number  $x_0$  of passengers that makes the total revenue a maximum.

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QUESTION # 6

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If  $y = x \ln x$ , determine where the function is both increasing and concave up.

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QUESTION # 7

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A balloon is being filled with helium at a rate of  $4 \text{ ft}^3/\text{min}$ . The rate, in square ft. per minute, at which the surface area is increasing when the volume is  $64\pi \text{ ft}^3$  is ?

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QUESTION # 8

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Write the equation of a line in standard form ( $Ax + By + C = 0$ ) which passes through the origin and is tangent to the curve  $y = e^{-2x}$ .

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QUESTION # 9

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Determine the  $c$  value for which the MVT applies to  $f(x) = x + 1/x$  on  $[1/2, 3/2]$ .

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QUESTION # 10

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Find all inflection points for the curve  $y = x^4 - 4x^2$ .

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QUESTION # 11

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Assume  $g(x) = \begin{cases} 2\arctan x, & x < 0 \\ e^x \cos x, & 2 > x \geq 0 \\ x^2 \ln x, & x > 2 \end{cases}$ .

Find and simplify  $g'(-1) + g'(0) - g''(e^e)$ .

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QUESTION # 12

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Find the global minimum of  $f(x) = \frac{64}{\sin x} + \frac{27}{\cos x}$  on  $(0, \pi/2)$ .

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QUESTION # 13

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Determine where  $f(x) = -4x^3 - 10x^2 - 6x + 4$  is decreasing.

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QUESTION # 14

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If  $y = (\tan x)^x$ , write the equation of the normal in standard form ( $Ax + By + C = 0$ ) at  $x = \pi/4$ .

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QUESTION # 15

JANUARY 8, 1994

Evaluate:  $\lim_{x \rightarrow 0} \frac{\tan^{-1} x - x}{8x^2}$