

#0 Mu School Bowl
MAΘ National Convention 2026

Evaluate the limit:

A) $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x}$

B) $\lim_{x \rightarrow 0} \frac{\sin x}{x}$

C) $\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$

D) $\lim_{x \rightarrow 0} x$

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#1 Mu School Bowl
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Evaluate the limit:

A) $\lim_{x \rightarrow 0} (x^3 - 2x^2 - 3x + 17)$

B) $\lim_{x \rightarrow 1} (x^3 - 2x^2 - 3x + 17)$

C) $\lim_{x \rightarrow 2} (x^3 - 2x^2 - 3x + 17)$

D) $\lim_{x \rightarrow 3} (x^3 - 2x^2 - 3x + 17)$

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D) $\lim_{x \rightarrow 3} (x^3 - 2x^2 - 3x + 17)$

#2 Mu School Bowl
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Evaluate:

A) $\lim_{x \rightarrow 2} \left(\frac{(x^3 - 2x^2 - 3x + 17) - (2^3 - 2 \cdot 2^2 - 3 \cdot 2 + 17)}{x - 2} \right)$

B) $\lim_{h \rightarrow 0} \left(\frac{((2+h)^3 - 2(2+h)^2 - 3(2+h) + 17) - (2^3 - 2 \cdot 2^2 - 3 \cdot 2 + 17)}{h} \right)$

C) $\left. \frac{dy}{dx} \right|_{x=2}$, where $y = x^3 - 2x^2 - 3x + 17$

D) the slope of the tangent line to $y = x^3 - 2x^2 - 3x + 17$ at the point where $x = 2$

#2 Mu School Bowl
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Evaluate:

A) $\lim_{x \rightarrow 2} \left(\frac{(x^3 - 2x^2 - 3x + 17) - (2^3 - 2 \cdot 2^2 - 3 \cdot 2 + 17)}{x - 2} \right)$

B) $\lim_{h \rightarrow 0} \left(\frac{((2+h)^3 - 2(2+h)^2 - 3(2+h) + 17) - (2^3 - 2 \cdot 2^2 - 3 \cdot 2 + 17)}{h} \right)$

C) $\left. \frac{dy}{dx} \right|_{x=2}$, where $y = x^3 - 2x^2 - 3x + 17$

D) the slope of the tangent line to $y = x^3 - 2x^2 - 3x + 17$ at the point where $x = 2$

#3 Mu School Bowl
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Let $f(x) = \frac{x^2}{x+1}$.

- A) Find the slope of the tangent line to $y = f(x)$ at the point where $x = 2$.
- B) Find the ordered pair for the local maximum of $y = f(x)$.
- C) For $x \in (-\infty, -3)$, does the tangent line to $y = f(x)$ at the point where $x = -3$ lie above or below $y = f(x)$? List only one of "above" or "below" as your answer.
- D) Use the tangent line approximation to $y = f(x)$ at the point where $x = 5$ to estimate $f(5.1)$.

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#4 Mu School Bowl
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- A) Find the maximum distance from the point $(0, -2)$ to the semicircle $y = \sqrt{36 - x^2}$.
- B) Find the minimum distance from the point $(4, 0)$ to the function $y = x^3$.
- C) Find the maximum volume of a rectangular prism with a square base such that the sum of the lengths of all of the edges of the prism equals 16.
- D) Find the maximum area of a rectangle with sides parallel to the x - and y -axes that is inscribed in the region bounded by the x - and y -axes and the graph of $y = 5 - x^3$.

#4 Mu School Bowl
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#5 Mu School Bowl
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- A) Find a root of $f(x) = x^2 - 2x - 11$ on the interval $(4, 5)$ that is guaranteed by the Intermediate Value Theorem.
- B) Find an x -value on the interval $(2, 3)$ that is guaranteed by the Mean Value Theorem for the function $f(x) = 2x^2 - 3x + 1$ on that interval.
- C) Find an x -value on the interval $(0, 1)$ that is guaranteed by Rolle's Theorem for the function $f(x) = x^3 - 3x^2 + 2x - 8$ on that interval.
- D) The Extreme Value Theorem guarantees that a maximum value of $f(x) = x^3 - 3x^2 - 24x + 12$ occurs at some x -value c on the interval $[-5, -1]$. Find the value of c .

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- D) The Extreme Value Theorem guarantees that a maximum value of $f(x) = x^3 - 3x^2 - 24x + 12$ occurs at some x -value c on the interval $[-5, -1]$. Find the value of c .

#6 Mu School Bowl
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Find the value of $\int_0^1 f(x)dx$ for the given function f :

A) $f(x) = x^2 - 6x + 3$

B) $f(x) = e^x - 2x$

C) $f(x) = \frac{2x}{x^2 + 1}$

D) $f(x) = \frac{2x^2}{x^2 + 1}$

#6 Mu School Bowl
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C) $f(x) = \frac{2x}{x^2 + 1}$

D) $f(x) = \frac{2x^2}{x^2 + 1}$

#7 Mu School Bowl
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Evaluate:

- A) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\left(\frac{2i}{n} \right)^3 - \left(\frac{2i}{n} \right)^2 + \left(\frac{2i}{n} \right) - 1 \right) \left(\frac{2}{n} \right) \right)$
- B) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\left(1 + \frac{2i}{n} \right)^3 - \left(1 + \frac{2i}{n} \right)^2 + \left(1 + \frac{2i}{n} \right) - 1 \right) \left(\frac{2}{n} \right) \right)$
- C) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\tan \left(\frac{\pi i}{4n} \right) \right) \left(\frac{\pi}{4n} \right) \right)$
- D) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\frac{6 - \left(\frac{i}{n} \right)}{\left(\left(\frac{i}{n} \right)^3 - 9 \left(\frac{i}{n} \right)^2 + 26 \left(\frac{i}{n} \right) - 24} \right) \left(\frac{1}{n} \right) \right)$

#7 Mu School Bowl
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- A) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\left(\frac{2i}{n} \right)^3 - \left(\frac{2i}{n} \right)^2 + \left(\frac{2i}{n} \right) - 1 \right) \left(\frac{2}{n} \right) \right)$
- B) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\left(1 + \frac{2i}{n} \right)^3 - \left(1 + \frac{2i}{n} \right)^2 + \left(1 + \frac{2i}{n} \right) - 1 \right) \left(\frac{2}{n} \right) \right)$
- C) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\tan \left(\frac{\pi i}{4n} \right) \right) \left(\frac{\pi}{4n} \right) \right)$
- D) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(\left(\frac{6 - \left(\frac{i}{n} \right)}{\left(\left(\frac{i}{n} \right)^3 - 9 \left(\frac{i}{n} \right)^2 + 26 \left(\frac{i}{n} \right) - 24} \right) \left(\frac{1}{n} \right) \right)$

#8 Mu School Bowl
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Find the area of the region bounded by the given graphs:

A) $y = 2 - x$, the x -axis, and the y -axis

B) $y = -\sqrt{9 - x^2}$ and the x -axis

C) $y = \frac{\sqrt{63 - 54x - 9x^2}}{4}$ and the x -axis

D) $y = 2x + 1$, $y = 3$, $y = 5$, and the y -axis

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D) $y = 2x + 1$, $y = 3$, $y = 5$, and the y -axis

#9 Mu School Bowl
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Find the volume of the solid generated by revolving the given region about the given line:

- A) the region bounded by $y = \sqrt{x}$, $x = 9$, and the x -axis; about the x -axis
- B) the region bounded by $y = \sqrt{x}$, $x = 9$, and the x -axis; about the y -axis
- C) the region bounded by $x = y^2 - 6y + 10$ and $x = 5$; about the x -axis
- D) the region bounded by $x = y^2 - 6y + 10$ and $x = 5$; about the y -axis

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Find the volume of the solid generated by revolving the given region about the given line:

- A) the region bounded by $y = \sqrt{x}$, $x = 9$, and the x -axis; about the x -axis
- B) the region bounded by $y = \sqrt{x}$, $x = 9$, and the x -axis; about the y -axis
- C) the region bounded by $x = y^2 - 6y + 10$ and $x = 5$; about the x -axis
- D) the region bounded by $x = y^2 - 6y + 10$ and $x = 5$; about the y -axis

#10 Mu School Bowl
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Find the particular solution, written in the form $y = f(x)$, to the differential equation with the given initial condition:

- A) $\frac{dy}{dx} = y, y(0) = 3$
- B) $\frac{dy}{dx} = xy + x, y(0) = 3$
- C) $\frac{dy}{dx} = \frac{xy}{x^2 + 1}, y(0) = 3$
- D) $\frac{dy}{dx} = \frac{e^x}{e^y}, y(0) = 3$

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#11 Mu School Bowl
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For each series, determine if the series converges. For your answers, write “yes” if the series converges, or write “no” if the series diverges:

A) $\sum_{n=1}^{\infty} \left(\frac{n}{n^2 + 1} \right)$

B) $\sum_{n=1}^{\infty} \left(\frac{n!}{n^n} \right)$

C) $\sum_{n=1}^{\infty} \left((-1)^{n-1} \left(\frac{\sqrt[3]{2n+1}}{\sqrt{2n-1}} \right) \right)$

D) $\sum_{n=1}^{\infty} \left(\frac{\cos n}{1 + n^2} \right)$

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D) $\sum_{n=1}^{\infty} \left(\frac{\cos n}{1 + n^2} \right)$

#12 Mu School Bowl
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In multivariable calculus, if $z = f(x, y)$, then f_x is called the partial derivative of f with respect to x and is found by differentiating, treating x as the independent variable while y is treated as a constant. Similarly, f_y is called the partial derivative of f with respect to y and is found by differentiating, treating y as the independent variable while x is treated as a constant.

Let $f(x, y) = 2x^2y - e^{xy} + \cos x$ and $g(x, y) = \frac{y}{x^2 + 1} - \sin^{-1}(xy) + \ln\left(\frac{y}{x+1}\right)$

- A) Find the value of $f_x(0, 3)$.
- B) Find the value of $f_y(0, 3)$.
- C) Find the value of $g_x(0, 3)$.
- D) Find the value of $g_y(0, 3)$.

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- A) Find the value of $f_x(0, 3)$.
- B) Find the value of $f_y(0, 3)$.
- C) Find the value of $g_x(0, 3)$.
- D) Find the value of $g_y(0, 3)$.

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- A) If $f(x) = 3x^2 + e^x + \tan x + \ln(x+1) + \tan^{-1} x$, find the value of $f'(0)$.
- B) Let $g(x) = 2^x - x$. Find the interval(s) where g is increasing, written in interval notation.
- C) Let $h(x) = \frac{1}{(x+1)^2 + 4} - \frac{1}{\sqrt{4-x^2}}$. Find the value of $\int_{-1}^1 h(x) dx$.
- D) Find the volume when the region bounded by $y = \sqrt{x}$ and $y = x^2$ is revolved about the line $x=1$.

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#14 Mu School Bowl
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Use the first two nonzero terms of the Maclaurin series of the integrand, when the series is written in order of increasing powers of x , to estimate the value of the integral:

- A) $\int_0^1 e^x dx$
- B) $\int_0^1 e^{x^2} dx$
- C) $\int_0^1 (\sin x) dx$
- D) $\int_0^1 (\tan^{-1} x) dx$

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