

**#1 Calculus - Hustle**  
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---

Find a polynomial expression for  $f'(x)$  if

$$f(x) = 3x^3 - 11x^2 - 10x + 5.$$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#1 Calculus - Hustle**  
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Round 1 2 3 4 5

**#2 Calculus - Hustle**  
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If  $g(x) = \frac{x^2 - 1}{2x^3 + 1}$ , evaluate  $g'(2)$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#2 Calculus - Hustle**  
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**#2 Calculus - Hustle**  
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Round 1 2 3 4 5

**#3 Calculus - Hustle**  
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Evaluate:  $\lim_{x \rightarrow -2} \frac{2x^2 - 10x - 28}{3x^2 + 2x - 8}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#3 Calculus - Hustle**  
**MA@ National Convention 2019**

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Evaluate:  $\lim_{x \rightarrow -2} \frac{2x^2 - 10x - 28}{3x^2 + 2x - 8}$

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#4 Calculus - Hustle**  
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---

Evaluate:  $\lim_{x \rightarrow \infty} \frac{2x^2 - 10x - 28}{3x^2 + 2x - 8}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#4 Calculus - Hustle**  
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Round 1 2 3 4 5

**#4 Calculus - Hustle**  
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Round 1 2 3 4 5

**#4 Calculus - Hustle**  
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Evaluate:  $\lim_{x \rightarrow \infty} \frac{2x^2 - 10x - 28}{3x^2 + 2x - 8}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#5 Calculus - Hustle**  
**MA $\text{\textcircled{C}}$  National Convention 2019**

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Find the open interval over which the function  $f(x) = x^3 + 3x^2 - 24x + 28$  is decreasing, written in interval notation.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#5 Calculus - Hustle**  
**MA $\text{\textcircled{C}}$  National Convention 2019**

---

Find the open interval over which the function  $f(x) = x^3 + 3x^2 - 24x + 28$  is decreasing, written in interval notation.

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**MA $\text{\textcircled{C}}$  National Convention 2019**

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**MA $\text{\textcircled{C}}$  National Convention 2019**

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Round 1 2 3 4 5

**#6 Calculus - Hustle**

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---

Find the ordered pair for the point of inflection of the function  $f(x) = x^3 + 3x^2 - 24x + 28$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#6 Calculus - Hustle**

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Find the ordered pair for the point of inflection of the function  $f(x) = x^3 + 3x^2 - 24x + 28$ .

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Round 1 2 3 4 5

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Round 1 2 3 4 5

**#6 Calculus - Hustle**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#7 Calculus - Hustle**  
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Evaluate:  $\int_0^1 \frac{2x}{x^2+1} dx$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#7 Calculus - Hustle**  
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---

Evaluate:  $\int_0^1 \frac{2x}{x^2+1} dx$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#7 Calculus - Hustle**  
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Evaluate:  $\int_0^1 \frac{2x}{x^2+1} dx$

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Round 1 2 3 4 5

**#7 Calculus - Hustle**  
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Evaluate:  $\int_0^1 \frac{2x}{x^2+1} dx$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#8 Calculus - Hustle**  
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---

Evaluate:  $\int_0^1 \frac{2}{x^2 + 1} dx$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#8 Calculus - Hustle**  
**MA $\odot$  National Convention 2019**

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Evaluate:  $\int_0^1 \frac{2}{x^2 + 1} dx$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

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Round 1 2 3 4 5

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Answer : \_\_\_\_\_

Round 1 2 3 4 5



**#9 Calculus - Hustle**  
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Evaluate:  $\lim_{x \rightarrow 0} \frac{\ln(1-x) - \sin x}{1 - \cos^2 x}$  (and yes, in case you were wondering, this is the limit from *Mean Girls*)

Answer : \_\_\_\_\_

Round 1 2 3 4 5

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Round 1 2 3 4 5

**#10 Calculus - Hustle**  
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Evaluate  $f''(e)$  for  $f(x) = x^x$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#10 Calculus - Hustle**  
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**MA $\odot$  National Convention 2019**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#11 Calculus – Hustle**  
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---

A sponge in the shape of a right circular cylinder is expanding in such a way that its base radius is always half of its height. At the moment when the base radius is 2 inches, the radius is expanding at a rate of 0.5 inch per second. Find the rate at which the volume of the sponge is expanding at this moment, in cubic inches per second.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#11 Calculus – Hustle**  
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Round 1 2 3 4 5

**#12 Calculus – Hustle**  
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The region bounded by the x-axis, the vertical lines  $x=1$  and  $x=e$ , and the curve  $y=\frac{1}{x}$  is divided into two regions of equal area by the vertical line  $x=a$ . Find the numerical value of  $a$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#12 Calculus – Hustle**  
**MA© National Convention 2019**

---

The region bounded by the x-axis, the vertical lines  $x=1$  and  $x=e$ , and the curve  $y=\frac{1}{x}$  is divided into two regions of equal area by the vertical line  $x=a$ . Find the numerical value of  $a$ .

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Round 1 2 3 4 5

**#13 Calculus – Hustle**  
**MA@ National Convention 2019**

---

Evaluate:  $\int_0^{\frac{\pi}{2}} (\sin^6 x) dx$  (hint: if you know Wallis's integral formulas, use them here)

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#13 Calculus – Hustle**  
**MA@ National Convention 2019**

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**MA@ National Convention 2019**

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Round 1 2 3 4 5

**#14 Calculus – Hustle**  
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---

Find the volume of the solid generated when the region in the first quadrant bounded by  $y=9-x^2$  and  $y=1+x^2$  is revolved about the  $y$ -axis.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#14 Calculus – Hustle**  
**MA© National Convention 2019**

---

Find the volume of the solid generated when the region in the first quadrant bounded by  $y=9-x^2$  and  $y=1+x^2$  is revolved about the  $y$ -axis.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#14 Calculus – Hustle**  
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Round 1 2 3 4 5

**#14 Calculus – Hustle**  
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#15 Calculus – Hustle**  
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---

A solid has a circular base with radius 4. Cross-sections perpendicular to the base are in the shape of a regular hexagon such that one side of the hexagon lies on the circular base. Find the volume of the solid.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#15 Calculus – Hustle**  
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Round 1 2 3 4 5

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#16 Calculus – Hustle**  
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---

A company can manufacture a maximum of 500 widgets per day. If the profit function for manufacturing  $x$  widgets on any day is given by

$$P(x) = 5000 + 2160x + 177x^2 - \frac{1}{3}x^3, \text{ find the}$$

number of widgets that should be manufactured to maximize the company's profit.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#16 Calculus – Hustle**  
**MA<sup>©</sup> National Convention 2019**

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**#16 Calculus – Hustle**  
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Round 1 2 3 4 5



**#17 Calculus – Hustle**  
**MA $\odot$  National Convention 2019**

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Suppose you want to find the real zero of the function  $f(x) = x^3 + x - 3$ , so you use Newton's Method with an initial guess of  $x_0 = 1$ . Find the first approximation  $x_1$  generated by Newton's Method under these conditions, written as a decimal.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#17 Calculus – Hustle**  
**MA $\odot$  National Convention 2019**

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**MA $\odot$  National Convention 2019**

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**MA $\odot$  National Convention 2019**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#18 Calculus – Hustle**  
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---

Find the solution, written in  $y = f(x)$  form, to  
the initial value problem  $\frac{dy}{dx} = 2xy, y(0) = 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#18 Calculus – Hustle**  
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---

Find the solution, written in  $y = f(x)$  form, to  
the initial value problem  $\frac{dy}{dx} = 2xy, y(0) = 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#18 Calculus – Hustle**  
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Round 1 2 3 4 5

**#18 Calculus – Hustle**  
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Calculus – Hustle**  
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---

Find the solution, written in  $y = f(x)$  form, to

the initial value problem  $x^2 \frac{dy}{dx} + 2xy = e^x$ ,

$y(1) = e$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Calculus – Hustle**  
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---

Find the solution, written in  $y = f(x)$  form, to

the initial value problem  $x^2 \frac{dy}{dx} + 2xy = e^x$ ,

$y(1) = e$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Calculus – Hustle**  
**MA© National Convention 2019**

---

Find the solution, written in  $y = f(x)$  form, to

the initial value problem  $x^2 \frac{dy}{dx} + 2xy = e^x$ ,

$y(1) = e$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Calculus – Hustle**  
**MA© National Convention 2019**

---

Find the solution, written in  $y = f(x)$  form, to

the initial value problem  $x^2 \frac{dy}{dx} + 2xy = e^x$ ,

$y(1) = e$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Calculus – Hustle**  
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Find the average value of the function

$f(x) = 6x^2 - 4x + 3$  on the interval  $[1, 3]$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Calculus – Hustle**  
**MA@ National Convention 2019**

---

Find the average value of the function

$f(x) = 6x^2 - 4x + 3$  on the interval  $[1, 3]$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Calculus – Hustle**  
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**#20 Calculus – Hustle**  
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Find the average value of the function

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#21 Calculus – Hustle**  
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---

Use Euler's Method with a step size of  $h = 0.2$  to approximate  $y(1.4)$  for the initial value problem  $y' = 2x + 3y, y(1) = 1$ . Write your answer as a decimal.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#21 Calculus – Hustle**  
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---

Use Euler's Method with a step size of  $h = 0.2$  to approximate  $y(1.4)$  for the initial value problem  $y' = 2x + 3y, y(1) = 1$ . Write your answer as a decimal.

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Round 1 2 3 4 5

**#21 Calculus – Hustle**  
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Round 1 2 3 4 5

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Calculus - Hustle**  
**MA@ National Convention 2019**

---

Evaluate:  $\sum_{n=0}^{\infty} \frac{1}{2^n \cdot n!}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Calculus - Hustle**  
**MA@ National Convention 2019**

---

Evaluate:  $\sum_{n=0}^{\infty} \frac{1}{2^n \cdot n!}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Calculus - Hustle**  
**MA@ National Convention 2019**

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Evaluate:  $\sum_{n=0}^{\infty} \frac{1}{2^n \cdot n!}$

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**MA@ National Convention 2019**

---

Evaluate:  $\sum_{n=0}^{\infty} \frac{1}{2^n \cdot n!}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

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Find the radius of convergence for the power series representation of the function

$$f(x) = \arctan x \text{ centered at } a = 0.$$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

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Round 1 2 3 4 5

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Find the third non-zero term of the Taylor series for  $f(x) = \ln(1-x)$  centered at  $a=0$ , where terms are written in increasing order of power of  $x$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

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---

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Round 1 2 3 4 5

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Round 1 2 3 4 5

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Answer : \_\_\_\_\_

Round 1 2 3 4 5



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If  $f$  is a twice-differentiable function on all real numbers such that  $f(0)=1$ ,  $f'(0)=1$ , and

$f''(0)=2$ , evaluate  $\lim_{x \rightarrow 0} \frac{f(x) - f'(x)}{f'(x) - 1}$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#25 Calculus - Hustle**  
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Round 1 2 3 4 5

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Round 1 2 3 4 5

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

