NMAθ 2002
ALPHA School Bowl

Round # _____

A = _____

B = _____

C = _____

Final answer:

CODE: _____

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Final answer:

CODE: _____

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Round 1

Part 1
A football team's scores as a function of practice time (in hours) is modeled by $y = -0.05x^2 + 2x + 7$. What is the optimum number of hours for them to practice?

A = the optimum number of hours

Part 2
Given $y = \frac{4}{3}\sin\left(x + \frac{3\pi}{5}\right) - \frac{2\pi}{3}$

B = the denominator of the sum of the period and the phase shift

Part 3
At what x values, if any, does the function $f(x) = \frac{x^2 - 9}{x^2 + 7x + 12}$, have a vertical asymptote?

C =
$$\begin{cases} \text{the x value of the asymptote} \\ \text{the sum of the x values of the asymptotes} \\ \text{nothing, if there are no vertical asymptote(s)} \end{cases}$$

Final answer = $\frac{A}{B} + C$

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Round 2

Part 1
Solve the inequality. Write answer in interval notation.

$x^3 + x^2 - x - 1 > 0$

A = lower bound of the interval

Part 2
A stunt driver drives a car over cliff into the sea. The car falls 4.9 m in the first second, 14.7 m in the second and 24.5 m in the third second, etc.

B = the number meters the car falls in the 6^{th} second

Part 3
Evaluate:

$$\begin{vmatrix} -3 & 2 \\ 1 & 5 \end{vmatrix} + \begin{vmatrix} 1 & -2 & -3 & 0 \\ -1 & 1 & 0 & 2 \\ 0 & 2 & 0 & 3 \\ 3 & 4 & 0 & 2 \end{vmatrix}$$

C = sum of the determinants

Final: $A + B + C$

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Round 3

Part 1

Given $f(x) = 5x - x^2$, find $\dfrac{f(5+h) - f(5)}{h}$

A = constant in the expression

Part 2

Find the equation of a parabola in general form if the parabola passes through the points A (-1,5), B (0, -1) and C (2, -1).

B = sum of the coefficients

Part 3

The one real zero of the function $f(x) = 3x^3 - 7x^2 - 7x - 10$ lies between what two consecutive integers?

C = product of the two integers

Final: $|A| + |B| - C$

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Round 4

Part 1

Solve for x: $8\left(2^{3x+1}\right)=\left(4^{3-x}\right)\left(16^{x}\right)$

A = x

Part 2

Find the exact solution set of the equation: $\log_4(x+12)=4-\log_4(x-12)$

B = x

Part 3

Solve for x on the interval $[0,2\pi)$ if $\cos x+\sin x\tan x=2$.

C = largest solution

Final: $12C\left(\frac{A}{B\pi}\right)$

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Round 5

Part 1

In the expansion of $(t-p)^8$, what is the coefficient of the term containing t^2?

A = coefficient

Part 2

Fourteen people are entered into a race. Assuming no ties, how many ways could the first three places be awarded?

B = number of ways

Part 3

The average of five students' test scores is 68. When the highest and lowest scores are eliminated, the average of the remaining scores is 72.

C = the average of the eliminated scores

Final: $\frac{B}{A} - C$

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A = coefficient

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Final: $\frac{B}{A} - C$

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Round 6

Part 1

$$\log_x \frac{1}{\sqrt{3}} = -\frac{1}{2}$$

A = x

Part 2
Given $x^2 + 4y + 17 = 10x - y^2$, find the center and radius.

B = sum of the center coordinates

Part 3
A water wave is created in a wave tank. It has an amplitude of 3 and a period of $\frac{2\pi}{3}$. Express the equation of the wave as a sine function.

C = sum of all the constants in the equation (hint: **A**sin(**B**x+**C**)+**D**=y)

Final: $B^A - C$

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Round 7

Part 1
Malone found the equation $h=-25(t-2)^2+100$ gave the height h (in feet) of his model rocket t seconds after it has been launched.

A = time the rocket was in the air

Part 2
In the food chain, barracuda feed on bass and bass feed on shrimp. Suppose that the size of the barracuda population is estimated by the function $r(x)=1000+\sqrt{20x}$, where x is the size of the bass population. Also suppose that the bass population is estimated by the function $s(x)=2500+\sqrt{x}$, where x is the size of the shrimp population.

B = barracuda population when the shrimp population is 4,000,000

Part 3
Given $f(x)=\frac{x+5}{x-5}$ and $f(x)=-3$

C = x when $f(x)=-3$

Final: $\frac{B}{A(C)}$

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C = x when $f(x)=-3$

Final: $\frac{B}{A(C)}$

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Round 8

Part 1
Evaluate exactly:

$$\sin^2 20^\circ + \frac{1}{\sec^2 20^\circ} + \frac{1}{\cos^2 40^\circ} - \tan^2 40^\circ$$

A = answer

Part 2
Find the exact value for $\sin\theta$ if

$\cos\theta = -\frac{3}{4}$ and θ is in quadrant III

B = $\sin\theta$

Part 3

Suppose that $\sin\theta + \cos\theta = 1.2$

What is the value of $\sin 2\theta$?

C = answer

Final: $25C - B^{-A}$

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What is the value of $\sin 2\theta$?

C = answer

Final: $25C - B^{-A}$

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Round 9

Part 1

Solve the system: $\begin{cases} x+y=2 \\ x+y^2=4 \end{cases}$

A = sum of all the coordinates of all the points of intersection

Part 2

A red die and a blue die are rolled simultaneously. What is the probability that the red die shows a larger number than the blue die?

B = denominator - numerator
(in lowest terms)

Part 3

Let $f(x)=3x+1$ and $g(x)=2x+5$

Then $f(g(x))-g(f(x))=?$

C = answer

Final: $6A-4B+C$

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Let $f(x)=3x+1$ and $g(x)=2x+5$

Then $f(g(x))-g(f(x))=?$

C = answer

Final: $6A-4B+C$

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Round 10

Part 1

$x^4 - 8x^3 + 17x^2 - 18x + 6 =$
$\left(x^2 + ax + 2\right)\left(x^2 + bx + 3\right)$

A = the value of ab

Part 2

Find the value of x such that
$4x + 6, x + 6, 4x - 2$ are the first 3 terms of an arithmetic sequence.

B = x

Part 3
Find the product of:

$$\left(\begin{bmatrix} 3 & 2 \\ -1 & 4 \end{bmatrix} \cdot \begin{bmatrix} 6 & 1 \\ 2 & 3 \end{bmatrix}\right) \cdot \begin{bmatrix} 2 \\ -1 \end{bmatrix}$$

C = answer matrix and take
entry R_1C_1 - R_2C_1

Final: $C - AB$

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$x^4 - 8x^3 + 17x^2 - 18x + 6 =$
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Part 2

Find the value of x such that
$4x + 6, x + 6, 4x - 2$ are the first 3 terms of an arithmetic sequence.

B = x

Part 3
Find the product of:

$$\left(\begin{bmatrix} 3 & 2 \\ -1 & 4 \end{bmatrix} \cdot \begin{bmatrix} 6 & 1 \\ 2 & 3 \end{bmatrix}\right) \cdot \begin{bmatrix} 2 \\ -1 \end{bmatrix}$$

C = answer matrix and take
entry R_1C_1 - R_2C_1

Final: $C - AB$