2014 Math Bowl

Junior Varsity Math Bowl

2014 JV Math Bowl

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Round 1

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I. Sample Question

Simplify:

$$\frac{321 - 123}{9}$$

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I. 1

Consider the equation

$$x^3 + 3x^2y + 3xy^2 + y^3 = 0.$$

Given that y = -1, solve for x.

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I.2

What is the largest even, prime factor of 2014?

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I. 3

One leg of a right triangle is 4 yards long. The other leg is 5 feet long. How long, in feet, is the hypotenuse?

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I. 4

Solve for x:

$$\frac{1}{4x-10} = \frac{1}{2x+16}$$

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I. 5

In triangle ABC, angle A measures 48 degrees. Angle B measures *x* more degrees than A, and angle C measures *x* more degrees than angle B. What is the measure of angle C?

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I.6

In the expansion of $(2x + y)^3$

what is the coefficient of x^2y

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I.7

What is the sum of the x- and y-intercepts of the line

$$3x + 5y = 30$$

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I.8

How many of the numbers between 100 and 120 are prime?

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I. 9

The surface area of a cube is 42. The length of the diagonal on the front face of the cube is $\sqrt{x}$. What is x ?

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I. 10

At the airport, every tenth passenger gets a 1-minute scan; the rest get 20-second scans. There are 10 lines. How many minutes are needed for the scans of 1000 passengers?

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Round 2

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II. Sample

Simplify

$$\frac{3/2}{3/14}$$

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II. 1

What number is next in the sequence:

$$1,2,6,24,120,\ldots?$$

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II.2

Solve for y:

$$3x - 2y + 40 = 30$$
$$2x + 3y - 40 = 27$$

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II. 3

What is the smallest number in the range of

$$f(x) = 2x^2 + 4x + 6$$

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II. 4

In the expansion of $(7x + 9y)^4$

what is the coefficient of x^3y^1

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II. 5

If Hong drives 70 mph and takes a 15-min break every two hours, how many hours will it take her to go 700 miles?

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II. 6

How many positive integers less than 2014 are squares?

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II. 7

Two standard dice are rolled. What is the probability that at least one of them is not odd?

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II. 8

In the following polynomial, one of the roots is 2. What is the product of the other two roots?

$$f(x) = x^3 - 4x^2 - 11x + 30$$

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II. 9

What is the largest odd factor of 2014?

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II. 10

A body builder lifts a 360 lb weight 10 times. A bricklayer lifts the same amount of weight, lifting 2-lb bricks during a six-hour shift. On average, how many seconds does it take to lay one brick?

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Round 3

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III. Sample

Simplify

$$\frac{8 \cdot 5 \cdot 7 \cdot 6}{4 \cdot 2 \cdot 3 \cdot 1}$$

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III. 1

The average of the set {1, 3, x, 4, 7, 8, 5} is 5. What is x?

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III. 2

The lines $3y = 5x - 40$ and $x + y = 0$ intersect in which quadrant?

(answer by entering 1, 2, 3, or 4)

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III. 3

A 48 inch long arrow was shot through the “equator” and center of a spherical pumpkin with 14 inch diameter. The arrow stopped when the middle of the arrow was at the center of the pumpkin. What is the distance, in inches from the top of the pumpkin to the tip of the arrow?

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III. 4

A convex polygon has 9 diagonals. How many edges does it have?

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III.5

The first slice of pizza has central angle 10 degrees. Each subsequent piece is 10 degrees bigger. What proportion of the whole pizza is the last piece (answer as a fraction in lowest terms)?

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III. 6

Rewrite as a simple fraction:

$$\cfrac{1}{2+\cfrac{1}{3+\cfrac{1}{4}}}$$

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III. 7

How many x-intercepts does the graph of

$$x^2 - 4x + y^2 + 6y = 1000$$

have?

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III.8

Shelly remembers that her PIN consisted of 4 distinct numbers from among 1,2,3,4,5,6 and that they were in decreasing order. How many such PINs are there?

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III.9

How many positive integer divisors does 360 have?

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III.10

What is the largest integer for which the spelling, in English, has more letters than the value of the number?

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Round 4

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IV. Sample

In a standard deck of cards, how many cards are either hearts or aces?

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IV. 1

Evaluate: 4^{2^3}

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IV. 2

Solve for x

$$27^{4x+3} = 9^{5x+7}$$

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IV. 3

Rewrite this repeating decimal as a simple fraction:

$0.10101010\ldots$

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IV. 4

Find $x+y+z$ if

$$x + y = 12$$
$$y + z = 26$$
$$z + x = 32$$

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IV.5

If all 10 nimblequats are among the 100 sesamebobs, and 50 of the sesamebobs are difficult, what is the maximum number of nimblequats that could be easy?

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IV.6

Simplify

$$\frac{\frac{8}{7}+\frac{6}{5}}{\frac{4}{3}+\frac{2}{1}}$$

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IV.7

The following represents a magic square. What are the numbers x, y, z?

$$\begin{bmatrix} x & y & z \\ a & 5 & b \\ 6 & d & 2 \end{bmatrix}$$

(answer as one 3 digit number)

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IV. 8

What is the number exactly half way between 1/ 2 and 1/3 ?

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IV. 9

What is the coefficient of the 2^{nd} degree term of

$$(x+2)(x-5)(x+14)$$

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IV. 10

Jane and Juan have invented a card game. From a standard deck of cards, a hand of three cards is dealt. It is a winning hand if exactly two of the three cards are the same suit. How many winning hands are there?

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will begin at 2:30

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Round I

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Sample Question:

Simplify

$$1111 \times 1001$$

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I.1

Simplify:

$$\log_6 4 + \log_6 9$$

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I.2

Two standard dice are rolled. What is the probability that at least one of them is not a 1?

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I.3

The lines $\frac{x}{5}+\frac{y}{6}=1$ and $y=x+7$

intersect in which quadrant?

(answer 1, 2, 3, or 4)

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I.3

The lines $\frac{x}{5}+\frac{y}{6}=1$ and $y=x+7$

intersect in which quadrant?

(answer 1, 2, 3, or 4)

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I.4

What is the smallest possible degree of a polynomial whose graph touches, but does not cross the x-axis at 4, 6, and 9?

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I.5

Convert the hexadecimal number AA to base 10.

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I. 6

Suppose $f(x) = 3.14x^7 + bx^3 + 3$ and $f(-3) = 5$.

What is $f(3)$?

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I.7

What is the sum of all the solutions of

$$3^{(x^2-7x+10)} = 81$$

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I.8

Let $f(x) = \frac{x!}{7}$, with domain the positive integers less than 100. How many numbers in the range are integers?

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I.9

A fair coin is tossed four times. The probability that the results (H or T) alternate is 1 out of how many?

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I.10

What is the square root of the sum of all the odd numbers less than 2014?

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Round II

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II. Sample

Simplify $e^{3\ln 4}$

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II.1

Evaluate $f(0.1)$, for

$$f(x) = (373x^2 + 241x - 0.83)^{1/3}$$

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II.2

What is the product of all the solutions of:

$$\log_3(x-2)+\log_3(x+4)=3$$

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II.3

Simplify

$$\sin\frac{\pi}{6}\cos\frac{\pi}{4}\tan\frac{\pi}{3}\cot\frac{\pi}{2}$$

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II.4

A regular polyhedron has 12 edges. What is the minimum number of vertices it could have?

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II.5

What is the smallest positive integer value of n such that

$$n^{700} > 5^{500}$$

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II.6

Quadrilateral ABCD is inscribed in a circle centered at P. The angle at A measures 101 degrees. What is the measure of the angle at C?

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II.7

What are the first 6 digits (bits) when 2014 is converted to base 2?

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II.8

What is the real part of

$$(4 + 3i)^2$$

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II.9

In the expansion of $(x+y+z)^3$

what is the coefficient of xyz

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II.10

What is the slope of the line that is asymptotic to the graph of

$$y = \frac{3x^3 + 4x^2 - 5x + 10}{x^2 + 8}$$

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Round III

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III. Sample

Simplify $\frac{4102 - 2014}{9}$

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III.1

Simplify

$$\arcsin\left(\frac{1}{3}\right) + \arccos\left(\frac{1}{3}\right)$$

(answer in degrees)

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III.2

Convert the hexadecimal number FF to base 10.

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III.3

If the numbers 7, 8, 9,..., 15 are placed in a 3x3 array so that each row and column add to the same sum (i.e. to form a magic square) what would the sum be?

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III.4

A line with slope 1 intersects the parabola $y = x^2$ at points A and B. The x-coordinate of A is -1. What is the y-coordinate of B?

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III.5

$$\lim_{x \to -4} \frac{\frac{1}{x} + \frac{1}{4}}{x + 4}$$

Determine

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The height, in meters, of a projectile t seconds after liftoff is given by the function

$$h(t) = -5t^2 + 400t$$

How long, in seconds, is the projectile above 7500 meters?

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III.7

Three years ago, Jose accepted 100 bitcoins in lieu of a $500 payment. Since then, the value of the bitcoins increased 1000%, until last week when the value of the coins went down by 50%. What is the current value of the bitcoins?

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III.8

What are the last 5 digits (bits) when 2014 is converted to base 2?

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III.9

A convex polygon has 20 sides. How many sides does it have?

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III.10

Let $f(x) = x\sin(3x)$

Determine $f'''\left(\frac{\pi}{6}\right)$

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Round IV

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IV. Sample

How many ways can the letters in “MATH” be rearranged?

IV.1 2014 Varsity Math Bowl

Assuming *A* and *B* are acute angles and

$$\sin A = 3/5, \sin B = 5/13\,.$$

Determine

$$\sin(A + B)$$

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IV.2

BC, CD, DE, EF are line segments, each of length 1. Triangles ABC, ACD, ADE, ADF have right angles at B, C, D, E, respectively. AB has length 1. AF has length $\sqrt{x}$. What is x ?

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IV. 3

Evaluate:

$$\lim_{x \to 0} 30 \frac{\tan x - \sin x}{x^3}$$

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IV.4

Ella's PIN has 4 non-zero digits. The first pair of digits differ by 1. The second pair differ by 2. How many such PINs are there?

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IV.5

What is the average value of

$$f(x) = 32x^3$$

on the interval (1/2, 3/2)?

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IV. 6

Convert the base 8 number 54 to base 2.

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IV. 7

The minute hand of a clock is pointed at 12. It is repeatedly moved (clockwise) 50 degrees. How many times will this happen before it points to 12 again?

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IV. 8

Oliver, Charlie, Billy, and Art line up randomly to get their daily gruel. What is the probability that none of them will be in the same place in line on Wednesday as he was on Monday?

(answer as a fraction in lowest terms)

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IV. 9

The letters in the word "mathematics" can be rearranged in $11!/x$ different ways.

Determine x

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IV. 10

An apartment complex is planned for 1 million people, to be housed in buildings each having 20 levels, with 10 units per level, each unit accommodating 4 people. The footprint of each building is 1 acre; each building has 1 acre of grounds and requires 1 acre of roadway. For every 50 buildings, there is an 11-acre park, with playground, parking area, and soccer field. How many acres will be needed for this complex?