Mathematics Contest Practice

UIL High School Mathematics - Grades 9-12 - 40 minutes

Write answers or mark the requested choices. Use a separate sheet if needed.
Scoring: +6 correct, -2 incorrect, 0 skipped.

1. Restaurant Tax Tip (Warmup)

Maya and Arlene ate lunch at Lakeside Diner. Both ordered the pasta bowl, which costs $16.13 each, and both ordered iced tea, which costs $2.01 each. They shared a slice of chocolate cake, which costs $5.88. The tax rate was 7.75%. Maya paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $14.60
B) $14.54
C) $14.57
D) $14.63
E) $14.51

2. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{60}$?

A) 25
B) 23
C) 20
D) 21
E) 19

3. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{87}$?

A) 5
B) 3
C) 8
D) 9
E) 6

4. Restaurant Tax Tip (Warmup)

Evan and Noah ate lunch at Maple Street Grill. Both ordered the brisket plate, which costs $14.00 each, and both ordered iced tea, which costs $2.76 each. They shared a slice of chocolate cake, which costs $4.66. The tax rate was 8.5%. Evan paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $18.54
B) $18.57
C) $18.63
D) $18.51
E) $18.60

5. Restaurant Tax Tip (Warmup)

Maya and Noah had dinner at Maple Street Grill. Maya ordered an entree for $16.24, dessert for $5.42, and a drink for $3.09. Noah ordered an entree for $18.31 and a drink for $3.09. The tax rate was 8.25%. Maya paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $10.12
B) $9.96
C) $10.00
D) $10.04
E) $10.08

6. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{55}$?

A) 4
B) 9
C) 6
D) 5
E) 2

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7. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{66}$?

A) 14
B) 10
C) 13
D) 18
E) 15

8. Restaurant Tax Tip (Warmup)

Evan and Sofia had dinner at Lakeside Diner. Evan ordered an entree for $16.74, dessert for $3.65, and a drink for $2.65. Sofia ordered an entree for $19.25 and a drink for $2.65. The tax rate was 9%.Evan paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $10.94
B) $10.98
C) $11.02
D) $11.06
E) $11.10

9. Restaurant Tax Tip (Warmup)

Jack and Noah had dinner at Lakeside Diner. Jack ordered an entree for $16.23, dessert for $4.92, and a drink for $2.91. Noah ordered an entree for $18.39 and a drink for $2.91. The tax rate was 9%.Jack paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $10.60
B) $10.64
C) $10.52
D) $10.48
E) $10.56

10. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{44}$?

A) 8
B) 5
C) 6
D) 11
E) 7

11. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{11}$?

A) 2
B) 1
C) 5
D) 3
E) 0

12. Restaurant Tax Tip (Warmup)

Anika and Noah had dinner at Blue Lantern Barbecue. Anika ordered an entree for $18.92, dessert for $6.35, and a drink for $2.82. Noah ordered an entree for $20.71 and a drink for $2.82. The tax rate was 8.5%.Anika paid with 4 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $24.03
B) $23.95
C) $23.99
D) $24.07
E) $23.91

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13. Restaurant Tax Tip (Warmup)

Evan and Luis ate lunch at Maple Street Grill. Both ordered the salmon dinner, which costs $12.27 each, and both ordered iced tea, which costs $1.83 each. They shared a slice of chocolate cake, which costs $6.49. The tax rate was 8.25%. Evan paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $22.42
B) $22.39
C) $22.51
D) $22.45
E) $22.48

14. Contest strategy: Integer constraints (Warmup)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{19}$?

A) 5
B) 0
C) 6
D) 2
E) 4

15. Restaurant Tax Tip (Warmup)

Maya and Luis had dinner at Pine Hill Cafe. Maya ordered an entree for $15.18, dessert for $5.04, and a drink for $2.75. Luis ordered an entree for $17.66 and a drink for $2.75. The tax rate was 7.75%. Maya paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $13.18
B) $13.30
C) $13.34
D) $13.26
E) $13.22

16. Contest strategy: Integer constraints (Standard)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{21}$?

A) 3
B) 8
C) 5
D) 2
E) 6

17. Contest strategy: Integer constraints (Standard)

How many pairs of positive integers (x, y) with $x <= y$ satisfy $1/x + 1/y = \frac{1}{13}$?

A) 0
B) 4
C) 2
D) 3
E) 1

18. Restaurant Tax Tip (Warmup)

Jack and Larry had dinner at Lakeside Diner. Jack ordered an entree for $14.32, dessert for $4.31, and a drink for $2.73. Larry ordered an entree for $16.69 and a drink for $2.73. The tax rate was 7.25%. Jack paid with 3 $20 bills and told the server to keep the change as a tip. How much was the tip?

A) $16.26
B) $16.22
C) $16.18
D) $16.34
E) $16.30

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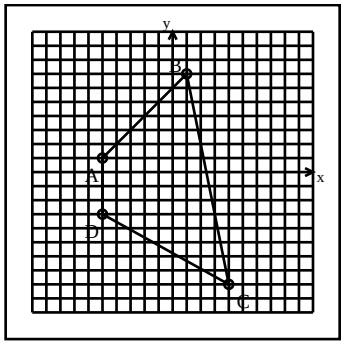
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19. Coordinate Triangle Perimeter (Standard)

Draw auxiliary segment BD. What is the perimeter of triangle BDC? Round to the nearest tenth.



A) 37.0

B) 36.7

C) 37.3

D) 37.9

E) 37.6

20. Sinusoidal Temperature Time (Standard)

Assume that the average low temperature in Bozeman in November is 14°F at 4:00 AM, and the average high temperature is 34°F at 4:00 PM. Assume the temperature varies sinusoidally each day. On a typical day, at what time does the morning temperature reach 31°F? Round to the nearest minute.

A) 1:02 PM

B) 12:54 PM

C) 12:58 PM

D) 12:50 PM

E) 1:06 PM

21. Radical Rational Domain (Standard)

Find the domain of the function $f(x) = \frac{x - 1}{\sqrt{(6 - x)}}$.

A) $x < 6$

B) $x <= 6$

C) $x > 6$

D) $x != 1$

E) $x != -1$

22. Coordinate Line Collinearity and Bisector (Standard)

Consider a line containing points A(-8, -2), B(4, 10), and C(d, 12). Find d to the nearest tenth.

A) 4

B) 5

C) 6

D) 8

E) 7

23. Contest strategy: Symmetric algebra (Standard)

Real numbers a and b satisfy $a + b = 5$ and $ab = 4$. Find the remainder when $a^4 + b^4$ is divided by 1000.

A) 257

B) 259

C) 253

D) 256

E) 260

24. Factorial Rational Sequence (Standard)

The rule $a_n = \frac{7n^2 + 6}{(n + 1)!}$, starting at $n = 1$, gives the sequence $\frac{13}{2}, \frac{17}{3}, \frac{23}{8}, \frac{59}{60}, \frac{181}{720}, \frac{43}{840}, \ldots$.

What is the next term? Round to the nearest

hundred-thousandth.

A) 0.00869

B) 0.00860

C) 0.00866

D) 0.00863

E) 0.00872

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25. Completing Square Added Term (Standard)

A student is solving $2x^2 + 1x - 32 = 0$ by completing the square. After dividing by 2 and moving the constant term, what value should be added to both sides?

A) $\frac{1}{8}$

B) $\frac{11}{48}$

C) $\frac{1}{16}$

D) $\frac{1}{32}$

E) $\frac{7}{48}$

26. Tangent Function Asymptote (Standard)

The graph of $y = 3\tan(0.1x)$ has a vertical asymptote at x = ____.

A) 7π

B) 4π

C) 6π

D) 3π

E) 5π

27. Arithmetic Sequence Sums (Standard)

Evaluate: $15 + 20 + 25 + \ldots + 85$.

A) 1500

B) 1275

C) 500

D) 665

E) 750

28. Nested Function Composition (Standard)

If $f(x) = \sqrt{(x^3 + 33)}$ and $h(x) = \ln(x) + 5$, find f(h(15)). Round to the nearest tenth.

A) 22.0

B) 22.4

C) 22.6

D) 21.8

E) 22.2

29. Parametric Point Value (Standard)

The point A(8, b) lies on the graph of the parametric equations $x(t) = \text{sqrt}(2t)$ and $y(t) = \frac{6}{t + 1}$, $0 <= t <= 60$.

Find b.

A) $\frac{3}{17}$

B) $\frac{2}{11}$

C) $\frac{5}{33}$

D) $\frac{7}{33}$

E) $\frac{3}{16}$

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30. Quadratic Root Sums (Standard)

The roots of the quadratic equation $4x^2 + bx + c = 0$ are -4 and 2.5. Find $b + c$.

A) -33

B) -32

C) -35

D) -36

E) -34

31. Rational Function Asymptote Count (Challenging)

The graph of $f(x) = \frac{x^2 + x - 30}{x^3 - 4x^2 - 36x + 144}$ has how many asymptotes?

A) 4

B) 3

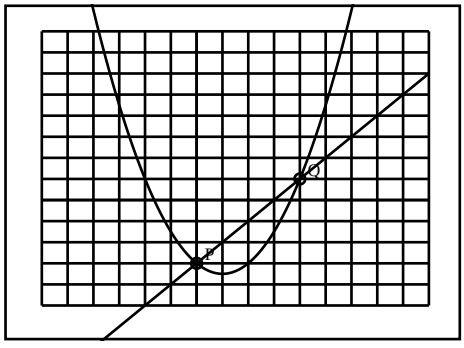
C) 0

D) 2

E) 1

32. Parabola Line Graph Features (Challenging)

Find the area of the region enclosed by $y = f(x)$ and $y = h(x)$. Round to the nearest tenth.



A) 20.7

B) 21.9

C) 21.3

D) 21.6

E) 21.0

33. Trigonometric Angle Sum (Challenging)

If $\cos ? = \frac{9}{41}$ and ? is in quadrant IV, and if $\tan ? = -\frac{15}{8}$ and ? is in quadrant II, what is the value of $\sin(? + ?)$?

A) $\frac{455}{697}$

B) $\frac{320}{697}$

C) $\frac{135}{697}$

D) $\frac{185}{697}$

E) $\frac{672}{697}$

34. Logarithmic Intensity Formula (Challenging)

The sound level of a sound is given by $? = 10\log(\frac{I}{I_0})$, where ? is measured in dB, I is intensity in W/m^2, and $I_0 = 10^{-12}$ W/m^2. Find the difference in sound levels for sounds with intensities 3.91×10^{-2} W/m^2 and 6.2×10^{-5} W/m^2. Round to the nearest whole number.

A) 36 dB

B) 28 dB

C) 20 dB

D) 32 dB

E) 24 dB

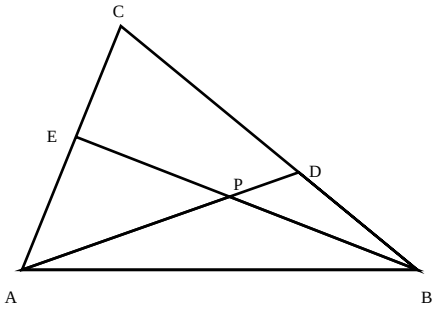
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35. Contest strategy: Intersecting cevians and areas (Challenging)
In triangle ABC, D lies on BC with BD:DC=2:3, and E lies on CA with CE:EA=5:6. Segments AD and BE meet at P. Triangle ABP has area 96. Find the area of ABC.



A) 323

B) 320

C) 316

D) 321

E) 322

36. Polygon Interior Angle Sums (Challenging)
The measure of an interior angle of a regular 57-gon is _____°.

A) $176\ \frac{16}{19}$ °

B) $3\ \frac{3}{19}$ °

C) 9900°

D) $173\ \frac{13}{19}$ °

E) $6\ \frac{6}{19}$ °

37. Circle Equation Coefficient Sum (Challenging)
Consider the circle $x^2 + y^2 + ax + by + c = 0$. The center of the circle is (-6, 7) and the diameter is 14. Find $a + b + c$.

A) 38

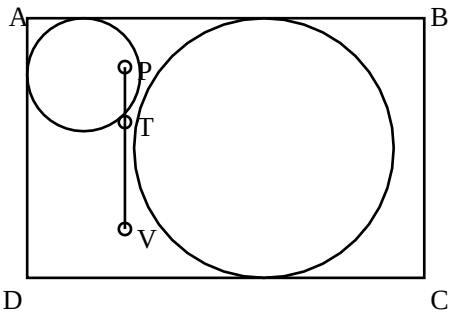
B) 36

C) 34

D) 30

E) 32

38. Tangent Circles Rectangle Diagonal (Challenging)
In rectangle ABCD, the height AD is 34.5 and the vertical segment PV has length 21.7, with PV parallel to BC. The two circles touch the rectangle sides and also touch each other at point T on PV. Determine the diagonal DB to the nearest tenth.



A) 57.0

B) 56.7

C) 56.1

D) 56.4

E) 55.8

39. Three-Dimensional Triangle Metrics (Challenging)
Consider triangle ABC with vertices A(-4, 5, 6), B(5, -2, -6), and C(1, -4, 0). Find the perimeter of triangle ABC. Round to the nearest tenth.

A) 35.8

B) 36.4

C) 35.6

D) 36.2

E) 36.0

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40. Guy Wire Trigonometric Distance (Challenging)

A stabilizing wire runs from the ground to the top of a 34-foot pole. The angle formed between the wire and the pole is 41°. How far from the base of the pole is the wire attached to the ground? Round to the nearest tenth.

A) 30.0
B) 29.6
C) 29.4
D) 29.8
E) 29.2

41. Unit Vector Linear Combination (Challenging)

Given vector $v = ?4, 1, 4?$ and vector $w = ?2, 9, 3?$. The unit vector in the direction of $4v + 2w$ is $?a/d, b/d, c/d?$. Find d. Round to the nearest hundredth.

A) 38.09
B) 34.79
C) 35.89
D) 39.19
E) 36.99

42. Ellipse Advanced Metrics (Challenging)

Consider the curve represented by the parametric equations $x = 9\cos(?)$ and $y = 7\sin(?)$. Find the distance between the foci. Round to the nearest tenth.

A) 11.5
B) 10.9
C) 11.3
D) 11.7
E) 11.1

43. Ellipse Axes Properties (Challenging)

Consider an ellipse with vertices (3, -1) and (3, 13), and with a minor axis of length 2. Find the area of the ellipse. Round to the nearest tenth.

A) 21.7
B) 22.0
C) 22.6
D) 21.4
E) 22.3

44. Hyperbola Eccentricity (Challenging)

Consider the hyperbola with equation $4y^2 - 25x^2 + 32y - 36 = 0$. Find the eccentricity of the hyperbola. Round to the nearest tenth.

A) 1.3
B) 0.9
C) 1.5
D) 1.1
E) 0.7

45. Regular Hexagon Circle Areas (Challenging)

A regular hexagon has area 619. What is the area of the circle inscribed in the hexagon? Round to the nearest whole number.

A) 553
B) 565
C) 557
D) 569
E) 561

46. Rectangular Fence Optimization (Hard)

A farmer wants to make a rectangular holding area using 420 feet of fence. One side will be the back side of a barn, so fencing is needed for only three sides. What is the maximum possible area of the holding area?

A) 22,050
B) 19,950
C) 24,150
D) 17,850
E) 26,250

47. Cone Lateral Area from Volume (Challenging)

The lateral area of a cone with a volume of 718 and a diameter of 14 is _____. Round to the nearest hundredth.

A) 344.07
B) 346.11
C) 342.03
D) 345.09
E) 343.05

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48. Similar Triangle Shadows (Challenging)

A measuring pole is 4 ft. 8 in. tall and has a 6 ft. 8 in. shadow. At the same moment, a field light has a 120-foot shadow. How tall is the field light? Round to the nearest foot.

A) 80 ft

B) 82 ft

C) 84 ft

D) 86 ft

E) 88 ft

49. Mean Confidence Interval (Hard)

In a random sample of 27 lab samples, the average mass was 15.7 grams with a sample standard deviation of 3.1 grams. Construct a 98%confidence interval for the mean mass. Round endpoints to the nearest hundredth.

A) {14.22, 17.18}

B) {14.44, 16.96}

C) {14.00, 17.40}

D) {14.10, 17.30}

E) {14.34, 17.06}

50. Conditional Probability Bayes (Hard)

At a school event, 50%of the students are girls and 50% are boys. Suppose 64%of the girls select soccer as their favorite sport, compared with 31%of the boys. If one person is randomly selected from those who select soccer as their favorite sport, what is the probability that the person is one of the girls? Round to the nearest hundredth.

A) 0.69

B) 0.67

C) 0.65

D) 0.63

E) 0.71

51. Small Data Set Outlier Mean Median (Hard)

A bowler recorded the scores from eight games. Use the table for the question. Find the absolute difference between the median and the mean. Round to the nearest hundredth.

Game	1	2	3	4	5	6	7	8
Score	218	251	234	272	222	196	210	165

A) 1.00

B) 1.03

C) 0.94

D) 0.97

E) 1.06

52. One Sample Proportion Test (Hard)

A quality-control team has a defect limit of 8%for a large shipment. From a random sample of 600 items, 59 are defective. The team runs the appropriate one-sided test at the ? = 0.05 level. Based on a P-value of _____, the shipment should be rejected. Round to the nearest thousandth.

A) 0.057

B) 0.049

C) 0.045

D) 0.041

E) 0.053

53. Normal Distribution Percentile (Hard)

Assume drive distances are approximately normal with mean 195 yards and standard deviation 16 yards. What value is required to be at the 84th percentile? Round to the nearest whole number.

A) 209 yards

B) 207 yards

C) 215 yards

D) 211 yards

E) 213 yards

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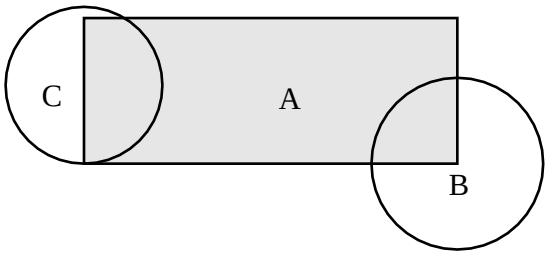
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54. Three-Set Inclusion-Exclusion (Hard)

Three garden beds overlap as shown. Bed A has 759 plants, bed B has 309 plants, and bed C has 214 plants. Beds A and B share 30 plants, while beds A and C share 80 plants. Beds B and C do not overlap. What is the total number of plants?



A) 1252

B) 1282

C) 1202

D) 1172

E) 1062

55. Comparative Z Scores (Hard)

Two athletes are compared using the distance distribution for each athlete's event. Athlete A's event has mean 66 ft 3 in and standard deviation 3 ft 5 in; Athlete B's event has mean 59 ft 5 in and standard deviation 3 ft 1 in. Athlete A records 77 ft 6 in and Athlete B records 69 ft 4 in. How much larger is Athlete A's z-score than Athlete B's? Round to the nearest thousandth.

A) 0.088

B) 0.076

C) 0.052

D) 0.100

E) 0.064

56. Normal Difference Distribution (Hard)

For masses of two independent samples, let $D = X - Y$. Suppose X is approximately normal with mean 0.29 and standard deviation 0.06, and Y is approximately normal with mean 0.23 and standard deviation 0.03. The mean of D is 0.06. What is the standard deviation of D? Round to the nearest hundredth.

A) 0.07

B) 0.06

C) 0.08

D) 0.09

E) 0.05

57. Trigonometric Curve Bounded Area (Hard)

Compute the first-quadrant area enclosed by the y-axis and the curves $y_1 = 27 + 7\cos(x)$ and $y_2 = 20 - 7\cos(x)$. Round to the nearest tenth.

A) 27.2

B) 26.8

C) 26.6

D) 27.0

E) 26.4

58. Particle Maximum Speed (Hard)

A particle moving along the x-axis has velocity $v(t) = 4(t + e^{0.2t})\cos(0.45t)$ for $0 <= t <= 9$. Find the maximum speed of the particle over this interval. Round to the nearest tenth.

A) 43.1

B) 39.4

C) 50.6

D) 46.9

E) 54.4

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59. Exponential Function Calculus Applications (Hard)

Given $h(x) = 6e^{0.25x}$ and $f(x) = 48$. The first-quadrant region bounded by the y-axis, $y = f(x)$, and $y = h(x)$ is revolved around the vertical line $x = 15$. Find the volume of the solid of revolution to the nearest whole number.

A) 17170

B) 17178

C) 17174

D) 17166

E) 17182

60. Square Base Box Optimization (Hard)

A closed rectangular box has a square base and must hold $360\ cm^3$. What is the least possible total surface area? Round to the nearest whole number.

A) 301

B) 310

C) 307

D) 298

E) 304

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Mathematics Practice Answer Key

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1. C
2. B
3. A
4. B
5. D
6. D
7. A
8. C
9. E
10. A
11. A
12. C
13. D
14. D
15. D
16. C
17. C
18. A
19. C
20. C
21. A
22. C
23. A
24. C
25. C
26. E
27. E
28. E
29. B
30. E
31. B
32. C
33. A
34. B
35. B
36. D
37. C
38. D
39. E
40. B
41. E
42. C
43. B
44. D
45. E
46. A
47. A
48. C
49. A
50. B
51. A
52. B

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53. D

54. D

55. B

56. A

57. B

58. D

59. C

60. E

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