RMSMC

Redmond Middle School Math Club

2425M

2024-2025 MATHCOUNTS Exam

Monday, January 13, 2024

INSTRUCTIONS

1. DO NOT BEGIN THIS EXAM UNTIL YOUR PROCTOR TELLS YOU.
2. This is a thirty question SHORT ANSWER test. All answers must be recorded in the correct location on the separate answer sheet.
3. SCORING: You will receive 1 point for each correct answer, 0 points for each problem left unanswered, and 0 points for each incorrect answer. Ties will be broken for top placement positions based on the highest numbered question answered correctly. If students are still tied, the process is repeated for the remainder of questions in reverse order. Exact ties will be broken at the sole discretion of the Math Club chair.
4. No aids are permitted other than scratch paper, graph paper, rulers, compass, protractors, and erasers. No calculators, smartwatches, or computing devices are allowed. No problems on the test will require the use of a calculator.
5. Figures are not necessarily drawn to scale.
6. Units are not necessary unless the question asks for time, where AM or PM should be specified.
7. Give all answers in simplest form, rationalizing the denominator if necessary. If you get a fractional answer, express it as a common fraction unless otherwise indicated. If the answer is dealing with money, then round to the nearest hundredth.
8. Please make sure to write your name where indicated.
9. When your proctor gives the signal, begin working on the problems. You will have 40 minutes to finish your exam.
10. When you finish the exam, please go over your answers again to check your work.

Questions for this exam were authored by Layla Kaim, Emma Li, and Sarah Wen.

ANSWER SHEET

Name	Score 1	Score 2	Final
Grade	Initial 1	Initial 2	

Do not write in shaded regions.

	Answer	1 or 0	1 or 0
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
1-15 Total			

	Answer	1 or 0	1 or 0
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
16-30 Total			

1. If $a\$b = 2a + b^2$, what is the value of 4$6?

2. Start with 12 and count by 4s to create the list 12, 16, 20, 24, …, P, where P is the 1000th number in the list. What is the value of P?

3. What is the value of $\frac{2^{32}-2^{29}}{2^{31}-2^{30}}$? Express your answer as a common faraction.

4. On the planet Rith, they use a different form of currency. On Rith, 7 $Icks$ are worth 23 $Bicks$ and 3 $Bicks$ and worth 14 $Micks$. How many $Micks$ are 21 $Icks$ worth?

5. Given that 1 mile = 8 furlongs and 1 furlong= 40 rods, what is the number of rods in one mile?

6. Deal City is having a sale on a video game that, because of its popularity, is notoriously hard to get a hold of. While waiting in line for Deal City to open (and the sale to begin), James notices that his friend Carlos is ahead of him and that there are only 5 people ahead of Carlos. If there is a total of 38 people in line, and 15 of those people are behind James, how many people are between James and Carlos?

7. Francesca uses 100 grams of lemon juice, 100 grams of sugar, and 400 grams of water to make lemonade. There are 25 calories in 100 grams of lemon juice and 386 calories in 100 grams of sugar. Water contains no calories. How many calories are in 200 grams of her lemonade?

8. Gerald is going mini golfing at Golf-O-Rama with his family. For his family of 5 to play it costs $34. They were charged for three student tickets and two adult tickets. If a student ticket costs 3/4 as much as an adult ticket costs, how much does one student ticket cost?

9. Out of 200 students, 120 study math, 150 study science, and 80 study both subjects. How many students study only one of the subjects?

10. When $x^2 - 8x - 209$ is written in factored form, what is the positive difference between the factors?

11. A sector of a circle has a central angle of 150°, and the circle's radius is $18\,cm$. What is the area of the sector in terms of π?

12. A triangle's vertices are at (1, 1), (6, 1), and (4, 5). Find its area.

13. At the beginning of the school year, Lisa's goal was to earn an A on at least 80% of her 50 quizzes for the year. She earned an A on 22 of the first 30 quizzes. If she is to achieve her goal, on at most how many of the remaining quizzes can she earn a grade lower than an A?

14. If x and y are positive odd integers such that $x(2^y) = 40$, then what is the value of $y(2^x)$?

15. A car travels the first third of a 180-*mile* journey at 60 *mph*, the next third at *90mph*, and the final third at *30mph*. What is the average speed for the entire trip?

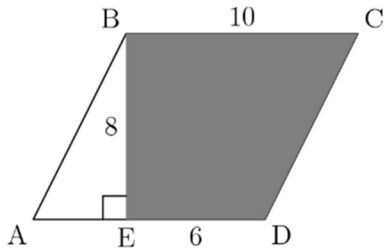
16. A square is inscribed in a circle with a radius of $10\,cm$. Given the side length can be written as $a\sqrt{b}$ in simplest form, what is $a \cdot b$?

17. If a and b are the roots of the polynomial $x^2 - 7x + 12$, find $a^2 + b^2$.

18. When Walter drove up to the gasoline pump, he noticed that his gasoline tank was $1/8$ full. He purchased 7.5 gallons of gasoline for 10 dollars. With this additional gasoline, his gasoline tank was then $5/8$ full. What is the number of gallons of gasoline his tank holds when it is full?

19. What is the sum of the greatest common divisor and least common multiple of 12^3 and 4^4?

20. What's the area of the shaded region BEDC in parallelogram ABCD?



21. 5 friends are watching a movie where they will be sitting side by side in one row. How many ways can they be seated if two specific people must sit next to each other?

22. A rectangle with vertices (2, 3), (8, 3), (8, 7), and (2, 7) is rotated 90 degrees clockwise about the origin. What are the new coordinates of the point originally at (8, 3)?

23. For how many three-digit whole numbers does the sum of the digits equal 25?

24. Pipes A, B, and C can fill a tank in 6, 9, and 12 hours, respectively. Pipe C is turned on first, followed by A an hour later, and B an hour after that. The number of hours it takes the pipes to fill the tank can be written as $a\frac{b}{c}$ in simplest form. What is $a + bc$?

25. Convert the base-8 number 7354 to base-10.

26. A circle has a radius of $15\,cm$. A chord is $9\,cm$ from the center. Find the length of the chord.

27. If a spherical ice cream scoop is placed in a waffle cone such that the radius and volume of the sphere and cone are the same, what is the square of the ratio of the surface area of the ice cream scoop to the waffle cone?

28. How many ways can you arrange the letters in the word "SQUARE" such that the vowels are in alphabetical order?

29. In a class of 50 students, 28 students study Mathematics, 22 study Science, and 18 study English. 12 students study both Mathematics and Science, 10 students study both Mathematics and English, 8 students study both Science and English, and 5 students study all three subjects. How many students do not study any of these three subjects?

30. In the figure below, segments NR and PO are chords of the circle, and segments NO and PR intersected at point Q. If $NQ = 6\,cm$, $NR = 21\,cm$, and $OP = 35\,cm$, what is the length of segment PQ?