

2014  
**AMC 10 A**

**DO NOT OPEN UNTIL TUESDAY, February 4, 2014**

**\*\*Administration On An Earlier Date Will Disqualify Your School's Results\*\***

1. All information (Rules and Instructions) needed to administer this exam is contained in the TEACHERS' MANUAL, which is outside of this package. PLEASE READ THE MANUAL BEFORE FEBRUARY 4, 2014. Nothing is needed from inside this package until February 4.
2. Your PRINCIPAL or VICE-PRINCIPAL must verify on the AMC 10 CERTIFICATION FORM (found in the Teachers' Manual) that you followed all rules associated with the conduct of the exam.
3. The Answer Forms must be mailed by trackable mail to the AMC office no later than 24 hours following the exam.
4. *The publication, reproduction or communication of the problems or solutions of this test during the period when students are eligible to participate seriously jeopardizes the integrity of the results. Dissemination at any time via copier, telephone, email, internet or media of any type is a violation of the competition rules.*

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American Mathematics Competitions

15<sup>th</sup> Annual

**AMC 10 A**

American Mathematics Contest 10 A

Tuesday, February 4, 2014

**INSTRUCTIONS**

1. DO NOT OPEN THIS BOOKLET UNTIL YOUR PROCTOR TELLS YOU.
2. This is a twenty-five question multiple choice test. Each question is followed by answers marked A, B, C, D and E. Only one of these is correct.
3. Mark your answer to each problem on the AMC 10 Answer Form with a #2 pencil. Check the blackened circles for accuracy and erase errors and stray marks completely. Only answers properly marked on the answer form will be graded.
4. SCORING: You will receive 6 points for each correct answer, 1.5 points for each problem left unanswered, and 0 points for each incorrect answer.
5. No aids are permitted other than scratch paper, graph paper, rulers, compass, protractors, and erasers. No calculators are allowed. No problems on the test will *require* the use of a calculator.
6. Figures are not necessarily drawn to scale.
7. Before beginning the test, your proctor will ask you to record certain information on the answer form.
8. When your proctor gives the signal, begin working on the problems. You will have **75 minutes** to complete the test.
9. When you finish the exam, *sign your name* in the space provided on the Answer Form.

The Committee on the American Mathematics Competitions (CAMC) reserves the right to re-examine students before deciding whether to grant official status to their scores. The CAMC also reserves the right to disqualify all scores from a school if it is determined that the required security procedures were not followed.

*Students who score 120 or above or finish in the top 2.5% on this AMC 10 will be invited to take the 32<sup>nd</sup> annual American Invitational Mathematics Examination (AIME) on Thursday, March 13, 2014 or Wednesday, March 26, 2014. More details about the AIME and other information are on the back page of this test booklet.*

The publication, reproduction or communication of the problems or solutions of the AMC 10 during the period when students are eligible to participate seriously jeopardizes the integrity of the results. Dissemination via copier, telephone, e-mail, World Wide Web or media of any type during this period is a violation of the competition rules. After the contest period, permission to make copies of problems in paper or electronic form including posting on web-pages for educational use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear the copyright notice.

1. What is  $10 \cdot (\frac{1}{2} + \frac{1}{5} + \frac{1}{10})^{-1}$ ?
- (A) 3    (B) 8    (C)  $\frac{25}{2}$     (D)  $\frac{170}{3}$     (E) 170
2. Roy's cat eats  $\frac{1}{3}$  of a can of cat food every morning and  $\frac{1}{4}$  of a can of cat food every evening. Before feeding his cat on Monday morning, Roy opened a box containing 6 cans of cat food. On what day of the week did the cat finish eating all the cat food in the box?
- (A) Tuesday    (B) Wednesday    (C) Thursday    (D) Friday  
(E) Saturday
3. Bridget bakes 48 loaves of bread for her bakery. She sells half of them in the morning for \$2.50 each. In the afternoon she sells two thirds of what she has left, and because they are not fresh, she charges only half price. In the late afternoon she sells the remaining loaves at a dollar each. Each loaf costs \$0.75 for her to make. In dollars, what is her profit for the day?
- (A) 24    (B) 36    (C) 44    (D) 48    (E) 52
4. Walking down Jane Street, Ralph passed four houses in a row, each painted a different color. He passed the orange house before the red house, and he passed the blue house before the yellow house. The blue house was not next to the yellow house. How many orderings of the colored houses are possible?
- (A) 2    (B) 3    (C) 4    (D) 5    (E) 6
5. On an algebra quiz, 10% of the students scored 70 points, 35% scored 80 points, 30% scored 90 points, and the rest scored 100 points. What is the difference between the mean and the median of the students' scores on this quiz?
- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5
6. Suppose that  $a$  cows give  $b$  gallons of milk in  $c$  days. At this rate, how many gallons of milk will  $d$  cows give in  $e$  days?
- (A)  $\frac{bde}{ac}$     (B)  $\frac{ac}{bde}$     (C)  $\frac{abde}{c}$     (D)  $\frac{bcde}{a}$     (E)  $\frac{abc}{de}$



## American Mathematics Competitions

### WRITE TO US!

*Correspondence about the problems and solutions for this AMC 10 and orders for publications should be addressed to:*

American Mathematics Competitions  
1740 Vine Street  
Lincoln, NE 68508

Phone 402-472-2257 | Fax 402-472-6087 | amcinfo@maa.org

*The problems and solutions for this AMC 10 were prepared by the MAA's Committee on the AMC 10 and AMC 12 under the direction of AMC 10 Subcommittee Chair:*

Dr. Leroy Wenstrom

### 2014 AIME

The 32<sup>nd</sup> annual AIME will be held on Thursday, March 13, with the alternate on Wednesday, March 26. It is a 15-question, 3-hour, integer-answer exam. You will be invited to participate only if you score 120 or above or finish in the top 2.5% of the AMC 10, or if you score 100 or above or finish in the top 5% of the AMC 12. Top-scoring students on the AMC 10/12/AIME will be selected to take the 43<sup>rd</sup> Annual USA Mathematical Olympiad (USAMO) on April 29-30, 2014. The best way to prepare for the AIME and USAMO is to study previous exams. Copies may be ordered as indicated below.

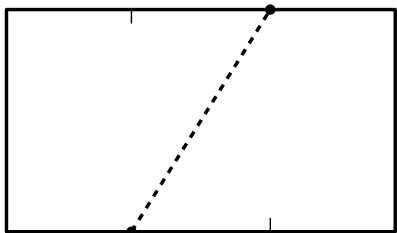
### **PUBLICATIONS**

A complete listing of current publications, with ordering instructions, is at our web site: [maa.org/math-competitions](http://maa.org/math-competitions)

22. In rectangle  $ABCD$ ,  $AB = 20$  and  $BC = 10$ . Let  $E$  be a point on  $\overline{CD}$  such that  $\angle CBE = 15^\circ$ . What is  $AE$ ?

- (A)  $\frac{20\sqrt{3}}{3}$     (B)  $10\sqrt{3}$     (C) 18    (D)  $11\sqrt{3}$     (E) 20

23. A rectangular piece of paper whose length is  $\sqrt{3}$  times the width has area  $A$ . The paper is divided into three equal sections along the opposite lengths, and then a dotted line is drawn from the first divider to the second divider on the opposite side as shown. The paper is then folded flat along this dotted line to create a new shape with area  $B$ . What is the ratio  $B : A$ ?



- (A) 1 : 2    (B) 3 : 5    (C) 2 : 3    (D) 3 : 4    (E) 4 : 5

24. A sequence of natural numbers is constructed by listing the first 4, then skipping one, listing the next 5, skipping 2, listing 6, skipping 3, and, on the  $n$ th iteration, listing  $n+3$  and skipping  $n$ . The sequence begins 1, 2, 3, 4, 6, 7, 8, 9, 10, 13. What is the 500,000th number in the sequence?

- (A) 996,506    (B) 996,507    (C) 996,508    (D) 996,509    (E) 996,510

25. The number  $5^{867}$  is between  $2^{2013}$  and  $2^{2014}$ . How many pairs of integers  $(m, n)$  are there such that  $1 \leq m \leq 2012$  and

$$5^n < 2^m < 2^{m+2} < 5^{n+1}?$$

- (A) 278    (B) 279    (C) 280    (D) 281    (E) 282

7. Nonzero real numbers  $x$ ,  $y$ ,  $a$ , and  $b$  satisfy  $x < a$  and  $y < b$ . How many of the following inequalities must be true?

- (I)  $x + y < a + b$   
 (II)  $x - y < a - b$   
 (III)  $xy < ab$   
 (IV)  $\frac{x}{y} < \frac{a}{b}$

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

8. Which of the following numbers is a perfect square?

- (A)  $\frac{14!15!}{2}$     (B)  $\frac{15!16!}{2}$     (C)  $\frac{16!17!}{2}$     (D)  $\frac{17!18!}{2}$     (E)  $\frac{18!19!}{2}$

9. The two legs of a right triangle, which are altitudes, have lengths  $2\sqrt{3}$  and 6. How long is the third altitude of the triangle?

- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5

10. Five positive consecutive integers starting with  $a$  have average  $b$ . What is the average of 5 consecutive integers that start with  $b$ ?

- (A)  $a + 3$     (B)  $a + 4$     (C)  $a + 5$     (D)  $a + 6$     (E)  $a + 7$

11. A customer who intends to purchase an appliance has three coupons, only one of which may be used:

Coupon 1: 10% off the listed price if the listed price is at least \$50

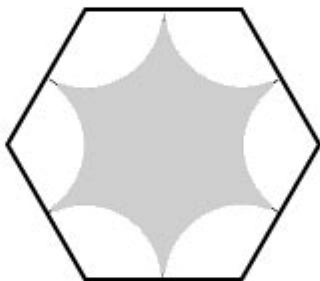
Coupon 2: \$20 off the listed price if the listed price is at least \$100

Coupon 3: 18% off the amount by which the listed price exceeds \$100

For which of the following listed prices will coupon 1 offer a greater price reduction than either coupon 2 or coupon 3?

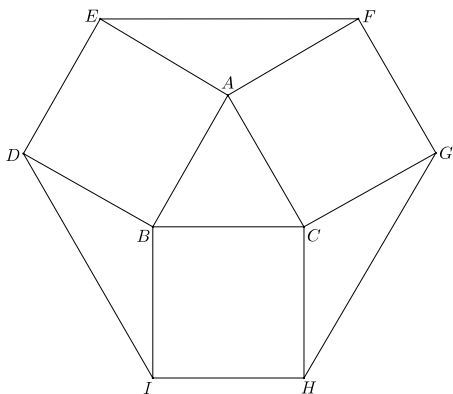
- (A) \$179.95    (B) \$199.95    (C) \$219.95    (D) \$239.95    (E) \$259.95

12. A regular hexagon has side length 6. Congruent arcs with radius 3 are drawn with the center at each of the vertices, creating circular sectors as shown. The region inside the hexagon but outside the sectors is shaded as shown. What is the area of the shaded region?



- (A)  $27\sqrt{3} - 9\pi$     (B)  $27\sqrt{3} - 6\pi$     (C)  $54\sqrt{3} - 18\pi$   
 (D)  $54\sqrt{3} - 12\pi$     (E)  $108\sqrt{3} - 9\pi$

13. Equilateral  $\triangle ABC$  has side length 1, and squares  $ABDE$ ,  $BCHI$ , and  $CAFG$  lie outside the triangle. What is the area of hexagon  $DEFGHI$ ?



- (A)  $\frac{12 + 3\sqrt{3}}{4}$     (B)  $\frac{9}{2}$     (C)  $3 + \sqrt{3}$     (D)  $\frac{6 + 3\sqrt{3}}{2}$     (E) 6

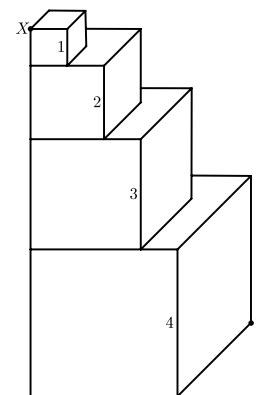
17. Three fair six-sided dice are rolled. What is the probability that the values shown on two of the dice sum to the value shown on the remaining die?

- (A)  $\frac{1}{6}$     (B)  $\frac{13}{72}$     (C)  $\frac{7}{36}$     (D)  $\frac{5}{24}$     (E)  $\frac{2}{9}$

18. A square in the coordinate plane has vertices whose  $y$ -coordinates are 0, 1, 4, and 5. What is the area of the square?

- (A) 16    (B) 17    (C) 25    (D) 26    (E) 27

19. Four cubes with edge lengths 1, 2, 3, and 4 are stacked as shown. What is the length of the portion of  $\overline{XY}$  contained in the cube with edge length 3?



- (A)  $\frac{3\sqrt{33}}{5}$     (B)  $2\sqrt{3}$     (C)  $\frac{2\sqrt{33}}{3}$     (D) 4    (E)  $3\sqrt{2}$

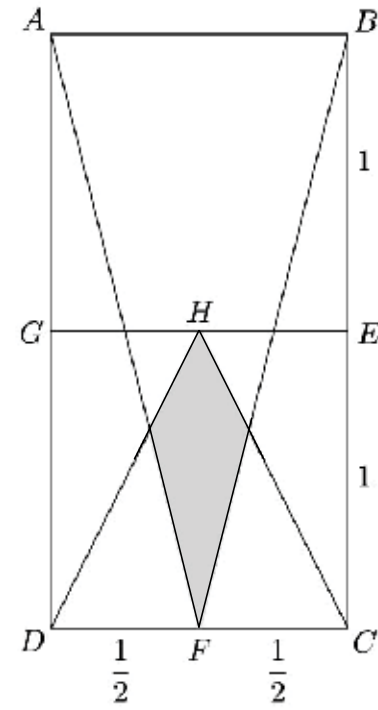
20. The product  $(8)(888\dots 8)$ , where the second factor has  $k$  digits, is an integer whose digits have a sum of 1000. What is  $k$ ?

- (A) 901    (B) 911    (C) 919    (D) 991    (E) 999

21. Positive integers  $a$  and  $b$  are such that the graphs of  $y = ax + 5$  and  $y = 3x + b$  intersect the  $x$ -axis at the same point. What is the sum of all possible  $x$ -coordinates of these points of intersection?

- (A) -20    (B) -18    (C) -15    (D) -12    (E) -8

14. The  $y$ -intercepts,  $P$  and  $Q$ , of two perpendicular lines intersecting at the point  $A(6, 8)$  have a sum of zero. What is the area of  $\triangle APQ$ ?
- (A) 45    (B) 48    (C) 54    (D) 60    (E) 72
15. David drives from his home to the airport to catch a flight. He drives 35 miles in the first hour, but realizes that he will be 1 hour late if he continues at this speed. He increases his speed by 15 miles per hour for the rest of the way to the airport and arrives 30 minutes early. How many miles is the airport from his home?
- (A) 140    (B) 175    (C) 210    (D) 245    (E) 280
16. In rectangle  $ABCD$ ,  $AB = 1$ ,  $BC = 2$ , and points  $E$ ,  $F$ , and  $G$  are midpoints of  $\overline{BC}$ ,  $\overline{CD}$ , and  $\overline{AD}$ , respectively. Point  $H$  is the midpoint of  $\overline{GE}$ . What is the area of the shaded region?



- (A)  $\frac{1}{12}$     (B)  $\frac{\sqrt{3}}{18}$     (C)  $\frac{\sqrt{2}}{12}$     (D)  $\frac{\sqrt{3}}{12}$     (E)  $\frac{1}{6}$