UNIVERSITY INTERSCHOLASTIC LEAGUE
Making a World of Difference

# Mathematics

## SAC • 2012

7 8 9

DO NOT TURN THIS PAGE UNTIL
YOU ARE INSTRUCTED TO DO SO!

1. Evaluate: $1 + 1 \times 2 - (3 + 5) \div 8 \times 13 + 21$

   (A) $-14.5$    (B) $-10$        (C) 5                (D) 11                (E) 30.75

2. The Retread Tire store has several package deals of sets of 4 tires. Which of the following is the best deal, assuming all of the tires are of the same quality?

   (A) $45 each                              (B)  buy 3 at $65 each, get the 4th one free
   (C) $55 each, but get 20% off for buying 4     (D)  $50 each for 3 and $25 for the 4th one
   (E) $60 for the 1st, $50 for the 2nd, $40 for the 3rd, and $30 for the 4th

3. Noah Dough has 9 canisters. Five canisters contain dimes, three contain nickels, and one contains both nickels and dimes. How many canisters contain neither nickels nor dimes?

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

4.
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            P          -2        Q          3          R
<------------|------------|------------|------------|------------|------------>
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   The distances between the hash marks ( | ) are equal. Find $P + Q + R$.

   (A) 0.5                (B) 1.5                (C) 2.5                (D) 3.0                (E) 4.5
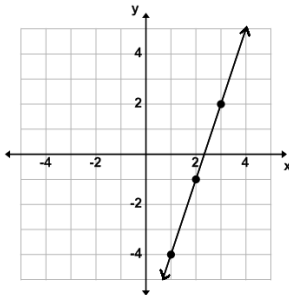
5. If the sum of the proper divisors of a number N is greater than N then N is a(n) _____ number.

   (A) abundant     (B) deficient        (C) odious        (D) perfect        (E) prime

6. The Real value solution set for $\left|5x - 3\right| < 2$ is?

   (A) $\{x \mid \frac{1}{5} < x < 1\}$        (B) $\{x \mid -1 < x < -\frac{1}{5}\}$        (C) $\{x \mid \{x > \frac{1}{5}\} \cup \{x < 1\}\}$
   (D) $\{x \mid 1 < x < 5\}$        (E) $\{x \mid \{x < \frac{1}{5}\} \cup \{x > 1\}\}$

7. What is the slope of the line perpendicular to the line shown?



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

8. Simplify:        $\left(\dfrac{x^2 + 4x + 4}{x^2 - 4}\right) \div \left(\dfrac{x^2 + x}{x^2 - x - 2}\right)$

   (A) $\dfrac{x + 2}{x}$            (B) $x + 2$            (C) $x^2 + 2x$        (D) $\dfrac{x(x - 1)}{x - 2}$            (E) $\dfrac{x + 2}{x(x + 1)}$

9. **Juana Cook knows that the number of cups she needs for her recipe is directly proportional to the number of servings needs. The recipe calls for 2 cups of sugar for 5 servings. How many cups of sugar will she need if she needs 25 servings for her family party?**

   (A) 3 cups     (B) 4 cups     (C) 8 cups     (D) 10 cups     (E) 13 cups

10. **Find the perimeter of the hexagon if DE = 2 cm. (nearest cm).**
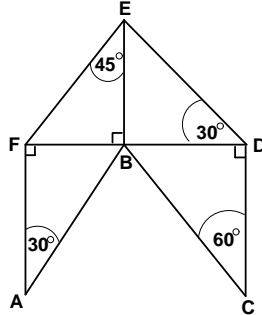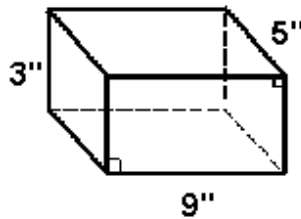


   (A) 14 cm     (B) 13 cm     (C) 12 cm     (D) 11 cm     (E) 10 cm

11. **Two lines that do not lie in the same plane and do not intersect are:**
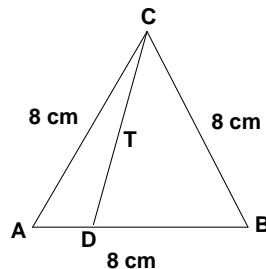
   (A) collinear     (B) concurrent   (C) parallel     (D) perpendicular       (E) skew

12. **Find the lateral surface area of the rectangular prism shown.**



   (A) 174 "     (B) 135 "     (C) 90 "     (D) 84 "     (E) 34"

13. **Find T if BD = 6 cm. (nearest tenth)**



   (A) 6.8 cm     (B) 7.0 cm     (C) 7.2 cm     (D) 7.4 cm     (E) 7.6 cm

14. **If $\dfrac{x-2}{2x+3} + \dfrac{3x+4}{4x-5} = \dfrac{Ax^2+Bx+C}{Px^2+Qx+R}$, then $\dfrac{A+B+C}{P+Q+R}$ equals:**

   (A) 1.44     (B) 1.2     (C) $-1$     (D) $-7.2$     (E) $-9.4$

15. **Find the average of all two-digit numbers such that reversing the digits results in another two-digit number that is 75% larger than the original two-digit number.**

   (A) 42          (B) 36          (C) 30          (D) 24          (E) 18

16. **Mark Deefield is roping off a triangle using main posts at three points. After putting in the first stake he walks 60 yards on a bearing of 100°. Then he walks 40 yards on a bearing of 200°. What will be the perimeter of Mark's triangle?   (nearest yard)**

   (A) 172 yds       (B) 166 yds       (C) 160 yds       (D) 154 yds       (E) 148 yds

17. **Ima Round draws a circle with a radius of 3 cm and the center at the origin O, in the x-y plane. Then she draws a line tangent to the circle at point P that intersects the x-axis at Q. Find PQ if $m\angle POQ = \frac{\pi}{6}$.**

   (A) $2\sqrt{3}$       (B) $\frac{2\sqrt{3}}{3}$       (C) $\frac{\sqrt{3}}{2}$       (D) $\frac{3\sqrt{3}}{2}$       (E) $\sqrt{3}$

18. **Use the Fibonacci characteristic sequence  ... p, — 2, q, 5, r, ... to  Find  $p + q + r$.**

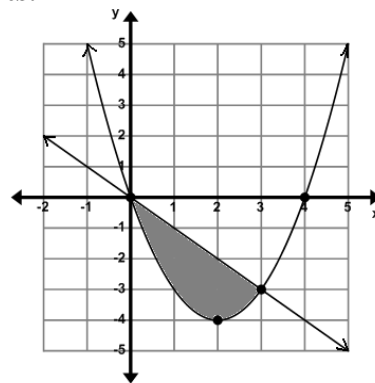   (A) 28          (B) 12          (C) 13          (D) 10          (E) 31?

19. **Let $A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & -2 \\ 1 & 0 \end{bmatrix}$. Find the sum of the elements of  $A(A + B)$.**

   (A) 0          (B) 3          (C) 4          (D) 5          (E) 6

20. **Let $f(x) = 5x^2 - 14x - 8$ and $g(x) = x - 1$.  Find $g(f'(x + 1))$**

   (A) $9x - 4$       (B) $10x - 5$       (C) $9x - 10$       (D) $10x - 14$       (E) $5x - 1$

21. **Find the area of the shaded region in square units.**



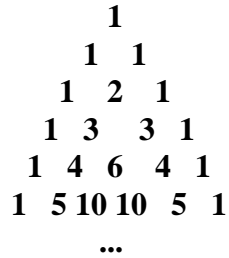   (A) 3.75          (B) 4          (C) 4.25          (D) 4.5          (E) 4.75

22. **How many distinguishable arrangements can be made from the letters "MATHTEST"?**

   (A) 20,160       (B) 6,720       (C) 40,320       (D) 3,360       (E) 13,440

23. **Willie Drawette has five blue markers, two green markers, four red markers and three black markers. Willie selects two markers at random. What is the probability that both of them are blue? (nearest per cent)**

   (A) 36%        (B) 31%        (C) 27%        (D) 11%        (E) 7%

24. **Using Blaise Pascal's triangle and letting the 1 at the top be row 1, determine which of the following numbers will be in the 9$^{th}$ row.**

$$1$$
$$1 \quad 1$$
$$1 \quad 2 \quad 1$$
$$1 \quad 3 \quad 3 \quad 1$$
$$1 \quad 4 \quad 6 \quad 4 \quad 1$$
$$1 \quad 5 \quad 10 \quad 10 \quad 5 \quad 1$$
$$...$$

   (A) 28            (B) 45            (C) 55            (D) 72            (E) 81

25. $8A_{16} + 42_8 + 21_4 = $ _____ $_2$

   (A) 10101010    (B) 11001101      (C) 11011011      (D) 10111011      (E) 10110101

26. **Find the next four-digit number in the following sequence:**
   9861    $-$ 1986    9681    $-$ 1896    8961    $-$1968    8691    ?????

   (A) $-$ 6918        (B) $-$ 1698        (C) $-$ 9816        (D) $-$ 6198        (E) $-$ 1869

## Mathematicians (No new ones this year.)

| | | | |
|---|---|---|---|
| Agnesi | Archimedes | Boole, George | Byron, Ada (Lady Lovelace) |
| Cantor, Georg | Descartes, Rene | Diophantus | Erastosthenes |
| Euclid | Euler, Leonard | Germain, Sophie | Goldbach, Christian |
| Hypatia | Kovalevsky, Sonya | Leibniz, Gottfried | Mandelbrot, Benoit |
| Napier, John | Noether, Emmy | Porter, Freda | Ptolemy, Claudius |
| Smith, Karen E. | Stott, Alicia | Theano | Venn, John |
| Williams, Grace | | | |

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## Types of Numbers (No new ones this year.)

| | | | | |
|---|---|---|---|---|
| Complex | Real | Imaginary | Rational | Irrational |
| Transcendental | Integer | Whole | Natural | Even |
| Odd | Prime | Composite | Unit | Deficient |
| Frugal | Economical | Perfect | Equidigital | Abundant |
| Extravagant | Wasteful | Fibonacci | Lucas | Happy |
| Unhappy | Lucky | Unlucky | Evil | Odious |
| Polite | Primeval | | | |

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**2012-13 Special Emphasis Concepts: Platonic Solids - Pascal's Triangle - Binomial Theorem**

 Possible questions (but not limited to) might include:

1.  The faces of a regular icosahedron are _____ .

2.  The dihedral angle on a dodecahedron with an edge of 3 cm is _____ .

3.  The simplified coefficient of the $x^3y$ term in the expansion of $(3x + 2y)^4$ is _____ .

4.  Set A = {1, 2, 3, 4, 5}. How many 3-element subsets of set A are there?

5.  If $f(x) = x^4 + 4x^3 + 6x^2 + 4x + 1$, then f(4) = _____ .

6.  Using Blaise Pascal's triangle and letting the 1 at the top be row 1, the sum of the elements in the 12th row.

7.  *** See #24 on the 2012SAC test.

| | | | |
|---|---|---|---|
| 1. | D | 21. | D |
| 2. | D | 22. | B |
| 3. | C | 23. | D |
| 4. | B | 24. | A |
| 5. | A | 25. | E |
| 6. | A | 26. | B |
| 7. | C | | |
| 8. | A | | |
| 9. | D | | |
| 10. | E | | |
| 11. | E | | |
| 12. | D | | |
| 13. | C | | |
| 14. | D | | |
| 15. | C | | |
| 16. | B | | |
| 17. | E | | |
| 18. | A | | |
| 19. | E | | |
| 20. | B | | |