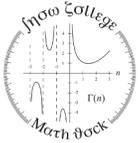# Snow College Jr. Mathematics Contest

Please read all instructions on this page very carefully.

1. Leave this booklet closed until you are instructed to begin.

2. Blacken the box for your test version (Form T) on the upper left side of the answer sheet. Make sure your answer sheet has your name already printed (if not, return to the registration table).

3. This is a one-hour examination consisting of 20 multiple choice problems. Completely blacken the box on the answer sheet for the single best answer to each question you choose to answer. Completely erase any answers you wish to change. Do not make stray marks outside the boxes.

4. Avoid random guessing as there is a penalty for wrong answers. There is no penalty for leaving a question blank. The formula for scoring the test is $\text{Score} = 20 + 4R - W$ where R and W denote the number right and wrong respectively. The possible scores range from 0 to 100.

5. Ties will be broken by the first discrepancy in the following five problems *in order*: 1, 2, 5, 14, 18. In the event of no discrepancies in those problems, the tie will be broken by a coin toss.

6. No calculators are allowed.   Diagrams are not necessarily drawn to scale.

7. Do not talk or disrupt other test takers during the exam. Cell phones must be OFF (not just on silent or vibrate, but OFF). No earbuds are allowed.

8. Please raise your hand if you need scratch paper or a new pencil; a proctor will assist you.

9. The proctors have been advised to **not** answer questions pertaining to the exam.

10. If you have time we recommend you recheck your answers. If you finish early you may quietly turn your answer sheet in and wait for the group competition. Please don't leave. After the one hour time limit is up the proctors will call for all answer sheets; hand them in promptly.

 After the test:

1. You may keep this test booklet and the pencils. There is a group activity during the 2nd hour.

2. For those who RSVP'd to take a department tour, consult information and signage for tours to start at 12:10. For those not touring a department, lunch may be purchased at the Snow College Cafeteria or downtown. In any event, you should plan to be back at the LDS Institute by 1:20 p.m. for the scores and presentation of the awards.

3. The top scorers from each grade 7–9 will be awarded a prize.

4. Thanks for coming; we hope you had fun and learned some math. Your instructors will be happy to work the problems for you. They will also be given your answer sheets.

Bubble in clearly the single best choice for each question you choose to answer.

1. Find the values of c such that the trinomial $x^2 + cx - 14$ can be factored.

   (A) $\{-13, -5, 5, 13\}$

   (B) $\{-15, -9, 9, 15\}$

   (C) $\{-19, -10, -4, 5\}$

   (D) $\{-14, -13, 13, 14\}$

   (E) $\{-15, -13, -9, -5, 5, 9, 13, 15\}$

2. Ted has a solid wooden cube with whole number dimensions (in centimeters). He paints the entire surface of the cube. Then, with slices parallel to the faces of the cube, Ted cuts it into $1\,\text{cm} \times 1\,\text{cm} \times 1\,\text{cm}$ cubes. Of the small cubes, x are completely free of paint and y are painted on only one side. If $y = 2x$, what was the side length of Ted's original cube?

   (A) $3\,\text{cm}$

   (B) $4\,\text{cm}$

   (C) $5\,\text{cm}$

   (D) $8\,\text{cm}$

   (E) $10\,\text{cm}$

3. A circle centered at O has chord AB which is $10\,\text{cm}$ long and is $12\,\text{cm}$ from O. What is the radius of the circle (in cm)?

   (A) 10

   (B) 12

   (C) $\sqrt{146}$

   (D) 13

   (E) $\sqrt{244}$
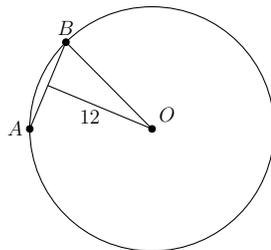
4. Bill jogs $\frac{1}{2}$ mile south, then $\frac{3}{4}$ mile east, and finally $\frac{1}{2}$ mile south. How many miles is he, in a direct line, from his starting point?

   (A) 1

   (B) $1\frac{1}{4}$

   (C) $1\frac{1}{2}$

   (D) $1\frac{3}{4}$

   (E) 2
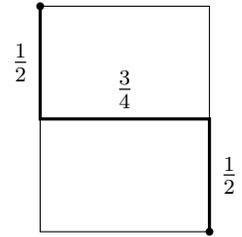
5. A string is wound symmetrically around a circular cylinder from one end to the other. The string goes exactly 4 times around the cylinder. The circumference of the cylinder is $4\,\text{cm}$ and it's length is $12\,\text{cm}$. Find the length of the string in cm.

   (A) 12π

   (B) 16π

   (C) $16\pi + 12$

   (D) 20

   (E) 28

6. The Fibonacci sequence $1, 1, 2, 3, 5, 8, 13, \ldots$ starts with two 1s, and each term afterwards is the sum of its two predecessors. Which of the digits 0 to 9 appears for the first time in the ones position of a number in the Fibonacci sequence later than every other digit?

   (A) 0

   (B) 4

   (C) 6

   (D) 7

   (E) 8

7. In the following diagram, five semicircles placed along segment AD have the same radius. The space between semicircles above the line is 5 cm and the space between the semicircles on the bottom of the segment is 50 cm. If the lengths of segments AB and CD are both 30 cm, what is the total length (in cm) of segment AD.

(A) 300

(B) 305

(C) 310

(D) 314

(E) 320
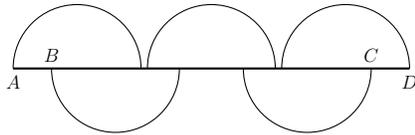
8. The smaller circles touch the larger circle and touch each other at the center of the larger circle. The radius of the larger circle is 6. What is the area of the shaded region?

(A) 6π

(B) 9π

(C) 12π

(D) 18π

(E) 27π
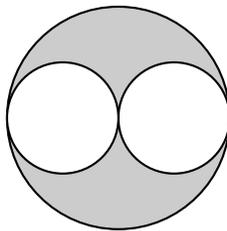
9. What is the angle between the two hands of a regular 12-hr analog clock at 2:30?

(A) 45°

(B) 60°

(C) 90°

(D) 105°

(E) 130°

10. In modular arithmetic, we care about the remainder (not the quotient) and we notate $a \equiv b \mod c$ if a/c has a remainder b. Fill in the blank. $87 \equiv \underline{\quad} \mod 13$.

(A) 9

(B) 6

(C) 4

(D) 13

(E) 5

11. A basketball player has made x shots out of y attempts. If she has made less than half her attempts, how many consecutive shots must she make until she has made exactly half her attempts?

(A) $2x$

(B) $y - 2x$

(C) $x + y$

(D) $2x + y$

(E) $y - x$

12. How many different ways can you orient a cube to fit into a cubic slot fitted for it?

(A) 12

(B) 16

(C) 20

(D) 24

(E) 28

13. The price of a stock rose 20% on Monday, fell 10% on Tuesday, and increased by 1/6 on Wednesday. By what percent did the price rise from before the market opened on Monday to after the market closed on Wednesday?

(A) 24

(B) 26

(C) 28

(D) 30

(E) 32

14. A balanced string of parentheses is one where every "(" is paired with a unique ")" further to the right. For instance, "(())()" is balanced. How many balanced strings can be constructed with 3 pairs of parentheses?

(A) 2

(B) 3

(C) 4

(D) 5

(E) 6

15. Solve the equation. $|x| = -x$

 (A) $x = 0$

 (B) $x \le 0$

 (C) $x < 0$

 (D) $x > 0$

 (E) $x \ge 0$

16. A vertical pole 12 feet tall casts a shadow 8 feet long. At the same time, a nearby tree casts a shadow 20 feet long. How tall is the tree?
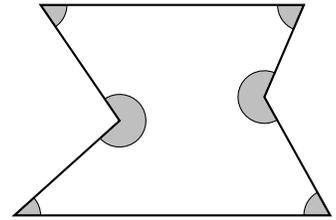
 (A) 24

 (B) 28

 (C) 30

 (D) 32

 (E) 36

17. If a recipe calls for $2\frac{3}{4}$ c flour to make 3 dozen cookies, how much flour is required to make 7 dozen cookies?

 (A) $4\frac{7}{12}$ c

 (B) $5\frac{1}{2}$ c

 (C) $6\frac{5}{12}$ c

 (D) $7\frac{7}{4}$ c

 (E) $19\frac{1}{4}$ c

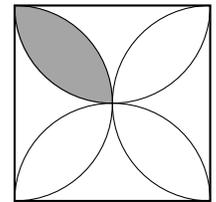18. If the top and bottom segments are parallel, what is the sum of the measures of all the interior angles in the concave hexagon?

 (A) 540°

 (B) 720°

 (C) 800°

 (D) 900°

 (E) 1080°

19. What is the area of the shaded region if the inside curves are semicircles inscribed in a square of side length 2?

 (A) $2 - \frac{\pi}{2}$

 (B) $1 - \frac{\pi}{4}$

 (C) $\pi - \frac{1}{2}$

 (D) $\frac{\pi}{2} - \frac{1}{2}$

 (E) $\frac{\pi}{2} - 1$

20. Solve the following equation for x.

$$\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{x}}}}}}} = 32$$

 (A) 2^4

 (B) 2^8

 (C) 2^{10}

 (D) 2^{12}

 (E) 2^{16}