

# Snow College Jr. Mathematics Contest

key

March 24, 2026

Junior Division: Grades 7–9

Form: T

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}

SOLN The possible combinations of factors of  $-14$  are:  $-1$  and  $14$ ,  $1$  and  $-14$ ,  $-2$  and  $7$ , and  $2$  and  $-7$ . The sums of the pairs are the possible values for  $c$ . □

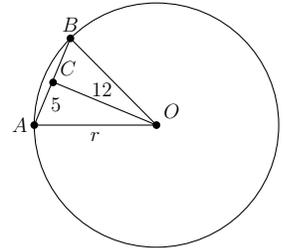
2. Ted has a solid wooden cube with whole number dimensions (in centimeters). He paints the entire surface of the cube. Then, with slices parallel to the faces of the cube, Ted cuts it into  $1\text{ cm} \times 1\text{ cm} \times 1\text{ cm}$  cubes. Of the small cubes,  $x$  are completely free of paint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

- (A) 3 cm  
 (B) 4 cm  
(C) 5 cm  
 (D) 8 cm  
 (E) 10 cm

SOLN Let  $n$  be the length of each side. On each row with interior cubes  $n - 2$  cubes will be interior.  $x = (n - 2)^3$  and  $y = 6 \cdot (n - 2)^2$ . Solve for  $n$  in  $6 \cdot (n - 2)^2 = 2 \cdot (n - 2)^3 \Rightarrow 3 = n - 2$ . By the way, the eight corner cubes have paint on three sides. □

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

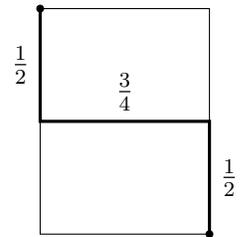
- (A) 10  
 (B) 12  
 (C)  $\sqrt{146}$   
(D) 13  
 (E)  $\sqrt{244}$



SOLN Draw line segment from  $O$  perpendicular to  $AB$  at  $C$ .  $\triangle OCB$  and  $\triangle OCA$  are right triangles so the Pythagorean theorem applies.  $OA = OB = 13$ . □

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



SOLN

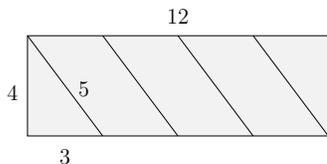
$$\sqrt{\left(\frac{1}{2} + \frac{1}{2}\right)^2 + \left(\frac{3}{4}\right)^2} = \sqrt{1 + \frac{9}{16}}$$

$$= \sqrt{\frac{25}{16}} = \frac{5}{4}$$

Also easily solved by scaling up by a factor of 4, seeing a 3, 4, 5 triangle, then scaling back down at the end. □

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 cm and it's length is 12 cm. Find the length of the string in cm.

- (A)  $12\pi$   
 (B)  $16\pi$   
 (C)  $16\pi + 12$   
 (D) 20  
 (E) 28



**SOLN** Cut the cylinder and string and unroll them to make a rectangle with sides 4 and 12; the string stretches across four times as shown. The left segment of the string is the hypotenuse of a 3-4-5 triangle. There are four such segments, so the total length is  $4 \times 5 = 20$ .  $\square$

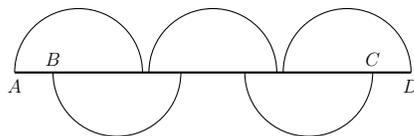
6. The Fibonacci sequence 1, 1, 2, 3, 5, 8, 13, ... starts with two 1s, and each term afterwards is the sum of its two predecessors. Which of the digits 0 to 9 appears for the first time in the ones position of a number in the Fibonacci sequence later than every other digit?

- (A) 0  
 (B) 4  
 (C) 6  
 (D) 7  
 (E) 8

**SOLN** Keep the arithmetic simple by keeping only the ones digit as you generate new numbers: 1, 1, 2, 3, 5, 8, 3, 1, 4, 5, 9, 4, 3, 7, 0, 7, 4, 1, 5, 6...  $\square$

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  $AD$ .

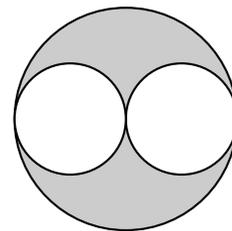
- (A) 300  
 (B) 305  
 (C) 310  
 (D) 314  
 (E) 320



**SOLN** Length using top measurements is  $6r + 10$ . Length using bottom measurements is  $4r + 110$ . Setting these equal and solving gives  $r = 50$  and the total length is  $6(50) + 10 = 310$  cm.  $\square$

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)  $6\pi$   
 (B)  $9\pi$   
 (C)  $12\pi$   
 (D)  $18\pi$   
 (E)  $27\pi$



**SOLN** Solve generally then plug in  $r = 6$ .

$$\begin{aligned}
 A_{\text{shaded}} &= \pi r^2 - 2 \left( \pi \left( \frac{r}{2} \right)^2 \right) \\
 &= \pi \left( r^2 - \frac{r^2}{2} \right) = \pi \left( \frac{r^2}{2} \right) \quad \square
 \end{aligned}$$

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

- (A)  $45^\circ$
- (B)  $60^\circ$
- (C)  $90^\circ$
- (D)  $105^\circ$
- (E)  $130^\circ$

*SOLN* A full circle is  $360^\circ$ . Divided among 12 numbers, the angle between any two hours is  $30^\circ$ . At 2:30, the hour hand is halfway between the 2 and the 3, so  $15^\circ$  above the 3. The minute hand is at the 6, an angle of  $90^\circ$  below the 3. So,  $15^\circ + 90^\circ = 105^\circ$ .  $\square$

10. In modular arithmetic, we care about the remainder (not the quotient) and we notate  $a \equiv b \pmod{c}$  if  $a/c$  has a remainder  $b$ . Fill in the blank.  $87 \equiv \underline{\hspace{1cm}} \pmod{13}$ .

- (A) 9
- (B) 6
- (C) 4
- (D) 13
- (E) 5

*SOLN*  $87 = 6 \times 13 + 9$ .  $\square$

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)  $y - x$

*SOLN* Let  $z$  be the number of future attempts needed. Set  $\frac{x+z}{y+z} = \frac{1}{2}$ . Then  $2x + 2z = y + z$ . Solve for  $z$  to get  $z = y - 2x$ .  $\square$

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

*SOLN* Six faces could be up. Each situation has four rotations.  $6 \times 4 = 24$ .  $\square$

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

*SOLN* Let  $s$  be the initial price. Monday:  $1.2s$ ; Tuesday:  $1.2s - 0.1(1.2s) = 1.08s$ ; Wednesday:  $1.08s + \frac{1}{6}(1.08s) = 1.26s$ .  $\square$

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

*SOLN* A good strategy is to answer the question for 1 pair, then 2 pairs, and then 3 pairs. For 1 pair we get “()”. For 2 pairs we get “()()” and “(())”. The 5 balanced strings for 3 pairs are “()()()”, “(())()”, “()(()),” “((()))”, “(())( )”.  $\square$

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

- (A)  $x = 0$
- (B)  $x \leq 0$
- (C)  $x < 0$
- (D)  $x > 0$
- (E)  $x \geq 0$

SOLN The absolute value of  $x$  is  $x$  when  $x \geq 0$  and it is  $-x$  when  $x < 0$ . Thus  $x = 0$  and any value  $x < 0$  will satisfy this inequality.  $\square$

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

SOLN The sun creates similar triangles (same angle of elevation). Thus the height-to-shadow ratios are equal:

$$\frac{12}{8} = \frac{h}{20}$$

So

$$h = 20 \cdot \frac{12}{8} = 30. \quad \square$$

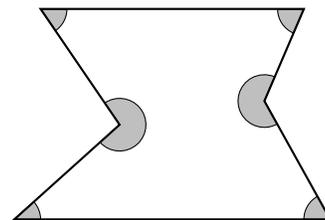
17. If a recipe calls for  $2\frac{3}{4}$  c flour to make 3 dozen cookies, how much flour is required to make 7 dozen cookies?

- (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

SOLN Use ratios:  $\frac{2\frac{3}{4} \text{ c}}{3 \text{ doz.}} = \frac{x \text{ c}}{7 \text{ doz.}}$   $\square$

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?

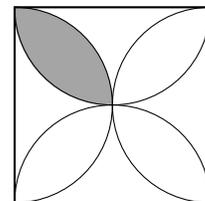
- (A)  $540^\circ$
- (B)  $720^\circ$
- (C)  $800^\circ$
- (D)  $900^\circ$
- (E)  $1080^\circ$



SOLN The sum of the interior angles of an  $n$ -gon is  $(n - 2) \times 180^\circ$ . Here the sum is  $(6 - 2) \times 180^\circ$ . That the top and bottom are parallel is irrelevant, as is the concave nature of the hexagon.  $\square$

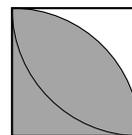
19. What is the area of the shaded region if the inside curves are semicircles inscribed in a square of side length 2?

- (A)  $2 - \frac{\pi}{2}$
- (B)  $1 - \frac{\pi}{4}$
- (C)  $\pi - \frac{1}{2}$
- (D)  $\frac{\pi}{2} - \frac{1}{2}$
- (E)  $\frac{\pi}{2} - 1$

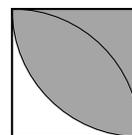


SOLN Since the side-length of the square is 2, the radii of the semicircles are each equal to 1. This means the area of the full circle is  $\pi$ , so a quarter of one of these circles has an area of  $\pi/4$ .

Look at the top-left quadrant of the original diagram.



This shows that the white region in each of the two diagrams is  $1 - \pi/4$ .



So the shaded area of the original diagram is  $1 - 2(1 - \pi/4) = \pi/2 - 1$   $\square$

20. Solve the following equation for  $x$ .

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

- (A)  $2^4$
- (B)  $2^8$
- (C)  $2^{10}$
- (D)  $2^{12}$
- (E)  $2^{16}$

SOLN Rewrite 32 as  $2^5$ . Square both sides.  
Do it again, again, and again.

$$\frac{x}{\sqrt{\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{x}}}}}}} = 2^{10}$$

$$\frac{x^2}{\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{x}}}}} = 2^{20}$$

$$\frac{x^4}{\frac{x^2}{\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{x}}}}} = 2^{40}$$

$$\frac{x^8}{\frac{x^4}{\frac{x^2}{\sqrt{\frac{x}{\sqrt{\frac{x}{\sqrt{x}}}}} = 2^{80}$$

The left side collapses down to  $x^5$  and the solution is  $x = (2^{80})^{1/5} = 2^{16}$ .  $\square$