



The CENTRE for EDUCATION  
in MATHEMATICS and COMPUTING  
*cemc.uwaterloo.ca*

# *Gauss Contest*

## *Grade 8*

*(The Grade 7 Contest is on the reverse side)*

**Wednesday, May 17, 2023**  
*(in North America and South America)*

**Thursday, May 18, 2023**  
*(outside of North America and South America)*



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**Time:** 1 hour

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Calculating devices are allowed, provided that they do not have any of the following features: (i) internet access, (ii) the ability to communicate with other devices, (iii) information previously stored by students (such as formulas, programs, notes, etc.), (iv) a computer algebra system, (v) dynamic geometry software.

### **Instructions**

1. Do not open the contest booklet until you are told to do so.
2. You may use rulers, compasses and paper for rough work.
3. Be sure that you understand the coding system for your answer sheet. If you are not sure, ask your teacher to explain it.
4. This is a multiple-choice test. Each question is followed by five possible answers marked **A, B, C, D,** and **E.** Only one of these is correct. When you have made your choice, enter the appropriate letter for that question on your answer sheet.
5. Scoring: Each correct answer is worth 5 in Part A, 6 in Part B, and 8 in Part C.  
There is *no penalty* for an incorrect answer.  
Each unanswered question is worth 2, to a maximum of 10 unanswered questions.
6. Diagrams are *not* drawn to scale. They are intended as aids only.
7. When your supervisor instructs you to start, you will have *sixty* minutes of working time.

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*The name, school and location of some top-scoring students will be published on the website, [cemc.uwaterloo.ca](http://cemc.uwaterloo.ca). On this website, you will also be able to find copies of past Contests and excellent resources for enrichment, problem solving and contest preparation.*

**Grade 8**

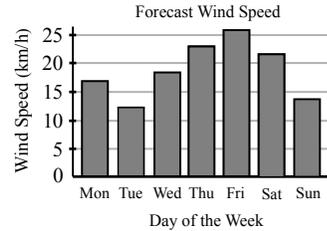
Scoring: There is *no penalty* for an incorrect answer.  
Each unanswered question is worth 2, to a maximum of 10 unanswered questions.

**Part A: Each correct answer is worth 5.**

1. Which of the following numbers is equivalent to the fraction  $\frac{1}{4}$ ?

- (A) 0.5            (B) 0.25            (C) 4.0            (D) 0.14            (E) 2.5

2. The graph shows the forecast wind speed (in km/h) during a 7-day period. Jack can sail alone only when the forecast wind speed is less than 20 km/h. During this 7-day period, on how many days will Jack be able to sail alone?



- (A) 4            (B) 6            (C) 1  
(D) 2            (E) 5

3. Which of the following numbers is *not* a multiple of 15?

- (A) 150            (B) 25            (C) 30            (D) 45            (E) 60

4. If the integers  $-7, 10, 9, 0, -9$  are ordered from least to greatest, what is the third integer in the list?

- (A)  $-7$             (B) 10            (C) 9            (D) 0            (E)  $-9$

5. If  $2n = 14$ , the value of  $10n$  is

- (A) 14            (B) 140            (C) 70            (D) 28            (E) 56

6. Tallulah is playing a game in which she rolls a single standard die once. If the number rolled is 1, 2, 3, or 4, then she wins. If the number rolled is 5 or 6, then she loses. What is the probability that she loses?

- (A)  $\frac{1}{3}$             (B)  $\frac{5}{6}$             (C)  $\frac{1}{2}$             (D)  $\frac{1}{6}$             (E)  $\frac{11}{12}$

7. In the addition shown,  $P$  and  $Q$  are each equal to a digit.

The value of  $P + Q$  is

- (A) 4            (B) 1            (C) 0  
(D) 3            (E) 5

$$\begin{array}{r} 1013 \\ + PQPQ \\ \hline 2023 \end{array}$$

8. In a salad dressing, the ratio of oil to vinegar is  $3 : 1$ . To make the dressing more acidic, the amount of vinegar is doubled. What is the new ratio of oil to vinegar?

- (A)  $3 : 2$             (B)  $6 : 1$             (C)  $1 : 3$             (D)  $2 : 3$             (E)  $4 : 3$

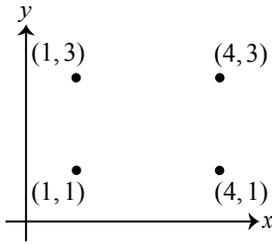
9. A grocery receipt shows the cost of three items before tax is added. A 5% tax is added to the cost of the items. The total cost of the three items, including tax, is

- (A) \$15.16            (B) \$15.08            (C) \$15.22  
(D) \$15.75            (E) \$15.38

Sponge	\$4.20
Shampoo	\$7.60
Soap	\$3.20

10. The vertices of a rectangle have coordinates  $(1, 3)$ ,  $(1, 1)$ ,  $(4, 1)$ , and  $(4, 3)$ , as shown. If the rectangle is reflected in the  $y$ -axis, which of the following points is *not* a vertex of the reflected rectangle?

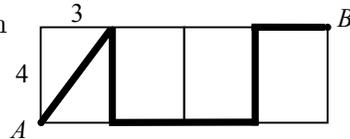
(A)  $(-1, 1)$     (B)  $(-4, 1)$     (C)  $(-3, 4)$   
 (D)  $(-1, 3)$     (E)  $(-4, 3)$



**Part B: Each correct answer is worth 6.**

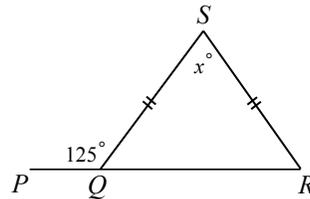
11. The diagram is made up of four congruent rectangles with dimensions 3 by 4. What is the length of the path from  $A$  to  $B$  shown on the diagram?

(A) 22    (B) 21    (C) 19  
 (D) 20    (E) 23



12. In the diagram,  $PQR$  is a line segment,  $\angle PQS = 125^\circ$ ,  $\angle QSR = x^\circ$ , and  $SQ = SR$ . What is the value of  $x$ ?

(A) 60    (B) 70    (C) 80  
 (D) 110    (E) 125



13. When attempting to arrange a pile of peaches into groups of threes, there are two peaches not in a group of three. Which of the following choices could be the number of peaches in the original pile?

(A) 19    (B) 49    (C) 33    (D) 29    (E) 61

14. A list of 5 integers repeats to form the pattern:

$$4, -3, 2, -1, 0, 4, -3, 2, -1, 0, \dots$$

What is the sum of the first 23 integers?

(A) 3    (B) 8    (C) 10    (D) 11    (E) 13

15. Bindu's bike tires have a radius of 30 cm. She rides her bike far enough that the tires rotate exactly five times. How far does Bindu's bike travel?

(A)  $60\pi$  cm    (B)  $30\pi$  cm    (C)  $900\pi$  cm    (D)  $300\pi$  cm    (E)  $150\pi$  cm

16. The numbers 41, 35, 19, 9, 26, 45, 13, 28 are arranged in pairs so that the sum of the numbers in each pair is the same. The number paired with 13 is

(A) 45    (B) 28    (C) 35    (D) 26    (E) 41

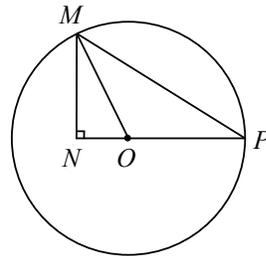
17. For 30 consecutive days, the daily high temperature was recorded. On each of the first 25 days, the temperature recorded was  $21^\circ\text{C}$ . On each of the remaining 5 days, the temperature recorded was  $15^\circ\text{C}$ . For the 30 days, the mean (average) of the temperatures recorded was

(A)  $17^\circ\text{C}$     (B)  $19^\circ\text{C}$     (C)  $20^\circ\text{C}$     (D)  $16^\circ\text{C}$     (E)  $18^\circ\text{C}$

18. The product of a pair of 2-digit positive integers is 630. How many such pairs are there?  
 (A) 2 (B) 3 (C) 4 (D) 5 (E) 6
19. At 9 a.m., Ryan had finished cutting  $\frac{1}{2}$  of his lawn. At 10 a.m., he had finished cutting  $\frac{7}{8}$  of his lawn. If Ryan cut his lawn at a constant rate, at what time did he finish?  
 (A) 10:15 a.m. (B) 11:20 a.m. (C) 10:20 a.m. (D) 10:30 a.m. (E) 11:40 a.m.
20. A  $4 \times 4$  grid is to be covered with 16 square tiles. There are four tiles in each of the colours red, black, green, and yellow. Each row must contain one tile of each colour. Each pair of tiles that touch along a side or at a corner must have different colours. In how many different ways can these tiles be arranged?  
 (A) 256 (B) 24 (C) 120 (D) 576 (E) 64

**Part C: Each correct answer is worth 8.**

21. In the diagram,  $O$  is the centre of a circle with radius 87, and  $P$  and  $M$  lie on the circle.  $N$  is positioned inside the circle so that  $PN$  passes through  $O$  and is perpendicular to  $MN$ . If  $MN = 63$ , what is the area of  $\triangle PMN$ ?  
 (A) 3370.5 (B) 3496.5 (C) 4725.0  
 (D) 4630.5 (E) 4126.5



22. It took Nasrin two hours and thirty minutes to canoe the 4.5 km into her camp. Paddling much faster, the return trip took her  $\frac{1}{3}$  of the time. What was Nasrin's mean (average) speed as she paddled to camp and back?  
 (A) 1.25 km/h (B) 3.96 km/h (C) 1.8 km/h (D) 1.95 km/h (E) 2.7 km/h
23. Each of two cylinders sits on one of their circular faces on a flat surface. Cylinder A, with radius 6 cm and height 50 cm, is empty. Cylinder B, with radius 8 cm and height 50 cm, is full of water. After pouring some water from Cylinder B into Cylinder A, the height of the water in both cylinders is the same. What is the height of the water? (The volume of a cylinder with radius  $r$  and height  $h$  is  $\pi r^2 h$ .)  
 (A) 28.1 cm (B) 25.0 cm (C) 32.0 cm (D) 44.4 cm (E) 28.6 cm
24. The number of pairs of integers  $a$  and  $b$  with  $a < b$  and  $a + b < 100$  satisfying the equation  $\frac{a}{4} + \frac{b}{10} = 7$  is  
 (A) 10 (B) 19 (C) 9 (D) 20 (E) 15
25. Given the list 2, 3, 4, 5, there are exactly three different ways to choose three integers from the list and form a triangle whose side lengths are equal to those integers. The integers chosen could be 2, 3, 4 or 2, 4, 5 or 3, 4, 5. The integers 2, 3, 5 cannot be used as side lengths of a triangle. Given the list 4, 10, 3,  $n$ , 13, there are exactly four different ways to choose three integers from the list and form a triangle whose side lengths are equal to those integers. If  $n$  is different from all other numbers in the list, then the sum of all possible values of  $n$  is  
 (A) 46 (B) 29 (C) 69 (D) 23 (E) 17