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

Gauss Contest

Grade 7

(The Grade 8 Contest is on the reverse side)

Wednesday, May 12, 2021
(in North America and South America)

Thursday, May 13, 2021
(outside of North America and South America)

Time: 1 hour

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.

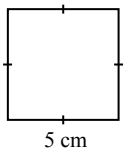
The name, school and location of some top-scoring students will be published on the website, cemc.uwaterloo.ca. On this website, you will also be able to find copies of past Contests and excellent resources for enrichment, problem solving and contest preparation.

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.

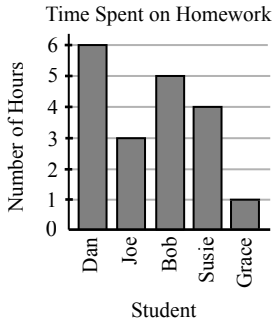
1. When the five numbers 10 000, 1, 10, 100, and 1000 are arranged from largest to smallest, the middle number is
(A) 10 000 **(B)** 1 **(C)** 10 **(D)** 100 **(E)** 1000

2. What is the perimeter of the square shown?
(A) 20 cm **(B)** 8 cm **(C)** 5 cm
(D) 50 cm **(E)** 15 cm



3. What value goes in the box to make the equation $5 + \square = 10 + 20$ true?
(A) 30 **(B)** 15 **(C)** 35 **(D)** 20 **(E)** 25

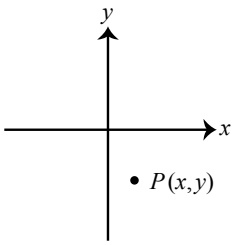
4. The number of hours spent by five students on homework is shown on the graph. Which two students, adding their individual times together, spent the same amount of time on homework as Dan?
(A) Joe and Grace
(B) Joe and Bob
(C) Bob and Grace
(D) Dan and Bob
(E) Susie and Grace



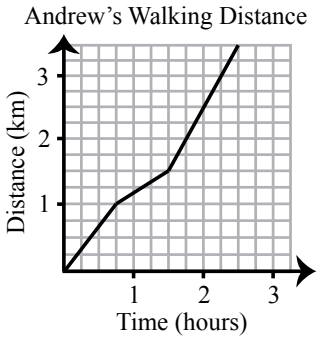
5. Which of the following fractions is closest to 0?
(A) $\frac{1}{2}$ **(B)** $\frac{1}{8}$ **(C)** $\frac{1}{3}$ **(D)** $\frac{1}{6}$ **(E)** $\frac{1}{9}$

6. A bag contains a number of candies. The probability of Judith choosing a red candy from this bag is $\frac{5}{6}$. The total number of candies in the bag could be
(A) 3 **(B)** 10 **(C)** 17 **(D)** 6 **(E)** 7

7. In the graph shown, which of the following statements is true about the coordinates of the point $P(x, y)$?
(A) The values of both x and y are positive.
(B) The value of x is positive and the value of y is negative.
(C) The value of x is negative and the value of y is positive.
(D) The values of both x and y are negative.
(E) The value of x is 0 and the value of y is negative.



8. The line graph shows the distance that Andrew walked over time. How long did it take Andrew to walk the first 2 km?
(A) 15 minutes
(B) 1 hour, 15 minutes
(C) 1 hour, 45 minutes
(D) 2 hours
(E) 45 minutes



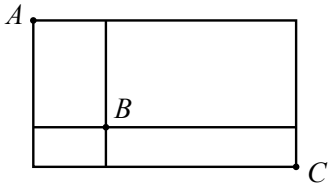
9. A list of five numbers repeats to form the pattern

$$5, 6, 7, 8, 9, 5, 6, 7, 8, 9, 5, 6, 7, 8, 9, \ldots$$

What is the 221^{st} number in the pattern?

(A) 5 **(B)** 6 **(C)** 7 **(D)** 8 **(E)** 9

10. An ant begins its path at A, travels only right or down, and remains on the line segments shown. The number of different paths from A to C that pass through B is



(A) 2 **(B)** 3 **(C)** 4 **(D)** 5 **(E)** 6

Part B: Each correct answer is worth 6.

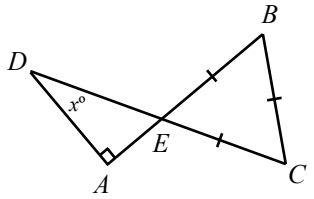
11. Laila writes a list of numbers. Her first number is 4. Each number after the first is 7 more than the previous number. Which of the following numbers appears in Laila's list?

(A) 45 **(B)** 46 **(C)** 47 **(D)** 48 **(E)** 49

12. The letter A has a vertical line of symmetry and the letter B does not. How many of the letters H L O R X D P E have a vertical line of symmetry?

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

13. In the diagram, AB and CD intersect at E. If $\triangle BCE$ is equilateral and $\triangle ADE$ is a right-angled triangle, what is the value of x?



(A) 90 **(B)** 60 **(C)** 25 **(D)** 45 **(E)** 30

14. Which of the following is the sum of three consecutive integers?

(A) 17 **(B)** 11 **(C)** 25 **(D)** 21 **(E)** 8

15. A positive integer whose digits are the same when read forwards or backwards is called a *palindrome*. An example of a palindrome is 13931. What is the sum of the digits of the next palindrome greater than 13931?

(A) 14 **(B)** 11 **(C)** 19 **(D)** 10 **(E)** 8

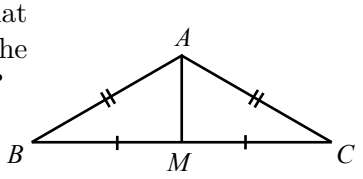
16. The number 6 has exactly 4 positive factors and the number 9 has exactly 3 positive factors. How many numbers in the list $14, 21, 28, 35, 42$ have exactly 4 positive factors?

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

17. The original price of a shirt is reduced by 50% to obtain a second price. The store advertises an additional sale, and so this second price is reduced by 40% to obtain a third price. What is the discount of the third price off the original price?

(A) 80% **(B)** 10% **(C)** 70% **(D)** 65% **(E)** 45%

18. In the diagram, $\triangle ABC$ is isosceles. M is on BC so that $BM = MC$. If the perimeter of $\triangle ABC$ is 64 and the perimeter of $\triangle ABM$ is 40, what is the length of AM?



(A) 10 **(B)** 8 **(C)** 16 **(D)** 12 **(E)** 24

19. Two *different* digits from 1 to 9 are chosen. One digit is placed in each box to complete the two 2-digit numbers shown. The result of subtracting the bottom number from the top number is calculated. How many of the possible results are positive?

$$\begin{array}{r} 5\square \\ -\,\square 5 \\ \hline \end{array}$$

(A) 36 **(B)** 32 **(C)** 30

(D) 34 **(E)** 38

20. Two standard dice are rolled. What is the probability that the sum of the numbers on the top faces is a prime number?

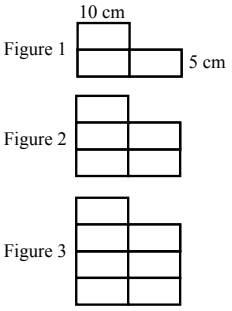
(A) $\frac{5}{12}$ **(B)** $\frac{7}{12}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{5}{6}$ **(E)** $\frac{1}{3}$

Part C: Each correct answer is worth 8.

21. A large number is written with a one followed by many zeros ($1000\ldots000$). When 1 is subtracted from this number, the sum of the digits in the result is 252. How many zeros are in the original number?

(A) 27 **(B)** 28 **(C)** 29 **(D)** 42 **(E)** 252

22. In the diagram shown, each figure after Figure 1 is formed by joining two rectangles to the bottom of the previous figure. Each individual rectangle has dimensions 10 cm by 5 cm. If Figure n has a perimeter of 710 cm, the value of n is



(A) 29 **(B)** 43 **(C)** 66

(D) 172 **(E)** 65

23. To *encode* a message, James first replaces each letter within the message with its corresponding number, where $A = 1$, $B = 2$, $\cdots$, $Y = 25$, and $Z = 26$. Next, James multiplies each number by 3 and then subtracts 5, and continues this process a total of n times. For example, when $n = 2$ the letter D is encoded to the number 16.

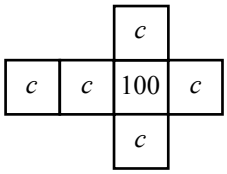
If James encoded a four letter message to the four numbers 367 205 853 1339, what is the value of n that he used?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5 **(E)** 6

24. How many different pairs of positive whole numbers have a greatest common factor of 4 and a lowest common multiple of 4620?

(A) 4 **(B)** 5 **(C)** 7 **(D)** 8 **(E)** 11

25. Jonas has 1728 copies of a $1 \times 1 \times 1$ cube with the net shown, where c is a positive integer and $c < 100$. Using these 1728 cubes, Jonas builds a large $12 \times 12 \times 12$ cube in such a way that the sum of the numbers on the exterior faces is as large as possible. For some values of c, the sum of the numbers on the exterior faces is between 80 000 and 85 000. The number of such values of c is



(A) 39 **(B)** 38 **(C)** 37

(D) 36 **(E)** 35