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2026 Gauss Contests

(Grades 7 and 8)

May 11 to May 22, 2026
(in North America and South America)

May 11 to May 22, 2026
(outside of North America and South America)

Solutions

Grade 7

1. In the diagram, there are 3 columns containing triangles that each contain 2 triangles.
So, there are $3 \times 2 = 6$ triangles.

Answer: (C)

2. When 3 is subtracted from 8, the result is 5. The integer that must replace the square is 8.

Answer: (B)

3. On a number line, the number -10 is 10 units left of 0. The number 9 is 9 units right of 0. Each of the remaining three choices is closer to 0 than -10 or 9. Of the given choices, -10 is farthest away from 0 on a number line.

Answer: (A)

4. Reading from the graph, Daia donated \$12, Joe donated \$6, Bel donated \$10, Susie donated \$8, and Zara donated \$2.
The total amount of money that they donated was $\$12 + \$6 + \$10 + \$8 + \$2 = \$38$.

Answer: (D)

5. Beginning at the rightmost digit and moving left, 5 is in the ones (units) place, 3 is in the tens place, 6 is in the hundreds place, 2 is in the thousands place, and 1 is in the ten-thousands place. Thus, the digit in the thousands place is 2.

Answer: (B)

6. Since $\angle PQR$ is a straight angle, its measure is 180°. Thus, the angles with measures 40° and x° have a sum of 180°, or $40 + x = 180$ and so $x = 180 - 40 = 140$.

Answer: (B)

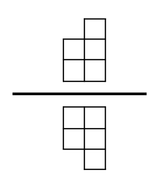
7. Suppose that each side of the square has length n cm, where n is a whole number. Then the perimeter of the square is $4 \times n$ cm. This means that the perimeter of the square in centimetres is a multiple of 4. Of the choices given, only 32 cm is a multiple of 4.
(We note that in this case, the square has side length $n = 8$ cm.)

Answer: (E)

8. On the second day, Mauricio walks $11 + 3 = 14$ minutes. On the third day he walks 17 minutes. On the fourth day, he walks 20 minutes. On the fifth day, he walks 23 minutes. In total, Mauricio walks $11 + 14 + 17 + 20 + 23 = 85$ minutes over the five days.

Answer: (A)

9. Following the reflection, the resulting shape is a mirror image of the original shape in the horizontal line. The resulting image has the same size and shape as the original. The diagram to the right has the original shape, the horizontal line, and the reflected image below it. The correct answer is the figure shown in (D).



Answer: (D)

10. The sequence contains the integers from 1 to 43 inclusive with the even integers removed. The first even integer removed is $2 = 2 \times 1$. The last even integer removed is $42 = 2 \times 21$, and so the 21 even integers between 1 and 43 were removed. Thus, the number of terms in the sequence is $43 - 21 = 22$.

Answer: (D)

11. The mean (average) of Lana's 4 jumps is $\dfrac{1.60\text{ m} + 1.65\text{ m} + 1.85\text{ m} + 1.90\text{ m}}{4} = \dfrac{7\text{ m}}{4} = 1.75\text{ m}$.
(In place of the calculation above, we may have noticed that 1.75 is "in the middle" of 1.65 and 1.85 (thus is the mean of these two numbers), and 1.75 is also in the middle of 1.60 and 1.90, and thus is the mean of the four numbers.)

ANSWER: (E)

12. We seek two positive integers that differ by 3 and whose sum is 27. With a small amount of trial and error, we determine that $15 - 12 = 3$ and $15 + 12 = 27$, and so Elsa is 12.

ANSWER: (C)

13. The area of $\triangle PQR$ is $\frac{1}{2} \times 8\text{ cm} \times 6\text{ cm} = 24\text{ cm}^2$.
The area of $\triangle PST$ is $\frac{1}{2} \times 4\text{ cm} \times 3\text{ cm} = 6\text{ cm}^2$.
The area of the shaded region is equal to the area of $\triangle PQR$ minus the area of $\triangle PST$, which is $24\text{ cm}^2 - 6\text{ cm}^2 = 18\text{ cm}^2$.

ANSWER: (A)

14. There are exactly 9 such integers. These are: 2026, 2062, 2206, 2260, 2602, 2620, 6022, 6202, 6220.

ANSWER: (E)

15. The net shown in (C) is *not* the net of a standard six-sided die.
On a standard six-sided die, the faces containing the numbers 3 and 4 must be opposite one another. In the net shown in (C), the numbers 3 and 4 are adjacent to one another, and thus when this net is folded into a die, the face containing the 3 will be adjacent to the face containing the 4, and so they will not be opposite one another.

ANSWER: (C)

16. When two standard six-sided dice are rolled, the minimum sum that can be rolled is $1 + 1 = 2$, and so Riah must move forward at least 2 squares on each roll.
This means that Riah cannot land on the square numbered 1, she can land on at most one of the squares numbered 11 and 12, and she can land on at most one of the squares numbered 16 and 17.
To achieve the maximum score possible, the goal is to land on as many shaded squares as possible, recognizing that a choice must be made between squares 11 and 12, and also between squares 16 and 17.
To begin the game, Riah cannot roll a 1, but she can roll a 3, thus adding 6 points to her score. She can then roll 3 again, adding 4 points to her score, followed by a roll of 2 to add 5 more points to her score. Riah is now on the square numbered 8, she has $6 + 4 + 5 = 15$ points, and she has collected the maximum number of points possible to this point in the game.
From the square numbered 8, Riah can roll a 3 and collect 7 points or she can roll a 4 and collect 8 points. Since landing on square 11 or 12 does not affect her ability to land on square 16 or 17, Riah maximizes her points by rolling 4 and collecting 8 points. She is now on the square numbered 12 and has $15 + 8 = 23$ points.
From the square numbered 12, Riah can roll a 4 and collect 10 points or she can roll a 5 and double her points. Since adding 10 points gives Riah $23 + 10 = 33$ and doubling her points gives $23 \times 2 = 46$, then rolling a 5 and landing on the square numbered 17 maximizes Riah's points. There are no more points that can be collected before finishing the game.
Thus, the greatest number of points that Riah can finish the game with is 46.

ANSWER: (B)

17. Asha could make one cut, cutting the ribbon into 2 pieces, each with length $\dfrac{36 \text{ m}}{2} = 18$ m.

She could make two cuts, cutting the ribbon into 3 pieces, each with length $\dfrac{36 \text{ m}}{3} = 12$ m.

Since the length of each of the equal pieces must be a whole number of metres, then the number of pieces must be a positive divisor of 36.

The positive divisors of 36 that are greater than 1 (since there must be at least one cut and so at least 2 pieces) are 2, 3, 4, 6, 9, 12, 18, and 36, and so there are 8 possibilities for the length of the smaller ribbons.

The possible lengths of the smaller pieces are 18 m, 12 m, $\dfrac{36 \text{ m}}{4} = 9$ m, $\dfrac{36 \text{ m}}{6} = 6$ m, $\dfrac{36 \text{ m}}{9} = 4$ m, $\dfrac{36 \text{ m}}{12} = 3$ m, $\dfrac{36 \text{ m}}{18} = 2$ m, and $\dfrac{36 \text{ m}}{36} = 1$ m.

Answer: (E)

18. We begin by determining the values of the digits B and C when $A < 9$. At the end of the solution we will show that the values of B and C are the same when $A = 9$.

Suppose that when $A < 9$, the value of $0.ABC$ rounded to the nearest tenth is $0.T00$.

Since $0.T00$ is 0.024 greater than $0.ABC$, then $0.ABC + 0.024 = 0.T00$.

The thousandths digit of $0.T00$ is 0, and so the sum of the thousandths digits, C and 4, ends in 0. Since C is at most 9, then $C + 4 = 10$, and so $C = 6$.

In this case, the 'carry' from the thousandths column to the hundredths column is 1.

The hundredths digit of $0.T00$ is 0, and so the sum of the hundredths digits, B and 2, added to the carry of 1, ends in 0. Since B is at most 9, then $B + 2 + 1 = 10$, and so $B = 7$.

In this case, the carry from the hundredths column to the tenths column is 1, and so $T = A+1$.

For any choice of the non-negative digit A, where $A < 9$, $0.A76+0.024 = 0.T00$ where $T = A+1$.

As examples, $0.876 + 0.024 = 0.900$ and $0.076 + 0.024 = 0.100$.

Finally, we show that when $A = 9$, the values of B and C remain the same.

The value of $0.9BC$ when rounded to the nearest tenth is greater than $0.9BC$, and therefore is equal to 1.

In this case, $0.9BC + 0.024 = 1$ or $0.9BC = 1 - 0.024 = 0.976$, and so $B = 7$ and $C = 6$.

Therefore, for all possible values of the non-negative digit A, we get $B + C = 7 + 6 = 13$.

Answer: (C)

19. Between 100 and 199 inclusive, the numbers that are divisible by 4 are:

$$4 \times 25 = 100, 4 \times 26 = 104, 4 \times 27 = 108, 4 \times 28 = 112, \ldots, 4 \times 49 = 196$$

Thus, there are $49 - 25 + 1 = 25$ such numbers.

Of these, 100, 112 and 120 are the only numbers whose digit sum is less than 5.

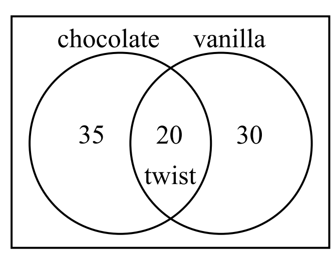
Therefore, between 100 and 199 inclusive, there are $25 - 3 = 22$ numbers that are divisible by 4 and for which the sum the digits of each number is 5 or more.

Answer: (C)

20. Of all 85 cones sold, $\dfrac{11}{17} \times 85 = 55$ cones contained some chocolate.

Of all 85 cones sold, $\dfrac{10}{17} \times 85 = 50$ cones contained some vanilla.

The total $55 + 50 = 105$ is more than the number of cones (85) because it counts each twist cone exactly twice. Thus, $105 - 85 = 20$ must equal the number of twist cones. That is, 20 cones were twist, $55 - 20 = 35$ cones were chocolate, and $50 - 20 = 30$ cones were vanilla, as shown in the Venn diagram.



Answer: (E)

21. $PQRS$ is a square with $PS = RS = 30$ cm.
Since $PU + UV + VS = PS = 30$ cm and $PU = UV = VS$, then $UV = \dfrac{30 \text{ cm}}{3} = 10$ cm.
$TUVW$ is a square with $UT = TW = VW = UV = 10$ cm.
$TXRW$ is a parallelogram, and so $XR = TW = 10$ cm.
The height of $TXRW$ is the vertical distance between its two parallel and horizontal sides TW and XR. This vertical height is equal to $RS + VW = 30 \text{ cm} + 10 \text{ cm} = 40$ cm.
The area of parallelogram $TXRW$ is the product of its base and its height, which is equal to $10 \text{ cm} \times 40 \text{ cm} = 400 \text{ cm}^2$.

ANSWER: (B)

22. Beverly writes down the value of `sum`, which is 0, as the first term of the sequence.
She then sets `sum` $=$ `sum` $+$ `a` $= 0 + 1 = 1$.
Beverly then writes down the value of `sum`, which is 1, as the second term of the sequence.
Since $a \neq 9$, she sets $a = a + 2 = 1 + 2 = 3$ and returns to Step 1.
In the table below, we keep track of the values of `sum` and `a`, as well as the terms of the sequence as Beverly progresses through the steps.

Values of `sum`	0	$0+1=1$	$1+3=4$	$4+5=9$	$9+7=16$	$16+9=25$
Sequence terms	0	1	4	9	16	25
Values of `a`	1	$1+2=3$	$3+2=5$	$5+2=7$	$7+2=9$	stop since $a=9$

Therefore, the last term in Beverly's sequence is 25.

ANSWER: (E)

23. In the second bowl, the ratio of the number of blueberries to the number of raspberries is $2 : 5$, and so the number of blueberries is a positive integer multiple of 2, and the number of raspberries is the same positive integer multiple of 5.
For example, there could be $2 \times 1 = 2$ blueberries and $5 \times 1 = 5$ raspberries, or $2 \times 2 = 4$ blueberries and $5 \times 2 = 10$ raspberries, and so on.
Thus, the number of raspberries in the second bowl has units digit 5 or 0.
There are a total of 89 raspberries, and so the number of raspberries in the first bowl must have units digit 4 (when the number of raspberries in the second bowl has units digit 5), or it must have units digit 9 (when the number of raspberries in the second bowl has units digit 0).
In the first bowl, the ratio of the number of blueberries to the number of raspberries is $3 : 7$, and so the number of raspberries is a positive integer multiple of 7.
The positive integer multiples of 7 less than 89 that have units digit 4 or 9 are 14, 49 and 84.

If the number of raspberries in the first bowl is 14, the number of raspberries in the second bowl is $89 - 14 = 75$.
If there are 14 raspberries in the first bowl, there are $3 \times \dfrac{14}{7} = 6$ blueberries in the first bowl ($6 : 14 = 3 : 7$).
If there are 75 raspberries in the second bowl, there are $2 \times \dfrac{75}{5} = 30$ blueberries in the second bowl ($30 : 75 = 2 : 5$).
In this case, the total number of blueberries is $6 + 30 = 36$.

If the number of raspberries in the first bowl is 49, the number of raspberries in the second bowl is $89 - 49 = 40$.
If there are 49 raspberries in the first bowl, there are $3 \times \dfrac{49}{7} = 21$ blueberries in the first bowl

$(21 : 49 = 3 : 7)$.
If there are 40 raspberries in the second bowl, there are $2 \times \dfrac{40}{5} = 16$ blueberries in the second bowl $(16 : 40 = 2 : 5)$.
In this case, the total number of blueberries is $21 + 16 = 37$.

If the number of raspberries in the first bowl is 84, the number of raspberries in the second bowl is $89 - 84 = 5$.
If there are 84 raspberries in the first bowl, there are $3 \times \dfrac{84}{7} = 36$ blueberries in the first bowl $(36 : 84 = 3 : 7)$.
If there are 5 raspberries in the second bowl, there are 2 blueberries in the second bowl.
In this case, the total number of blueberries is $36 + 2 = 38$.

Thus, the smallest possible number of blueberries is 36.

Answer: (A)

24. The integer abc is divisible by 5, and so $c = 5$ (since $c = 0$ is not possible).
The integer $cde = 5de$ is divisible by 11. The integers $5de$ having different non-zero digits that are divisible by 11 are 517, 528, 539, 561, 572, 583 and 594.
Next, we determine the smallest five-digit integer for which $5de$ is equal to one of the seven possibilities above. The smallest five-digit integers $abcde$ with different digits have $a = 1$ and $b = 2$.
Since the digits must be different, then 12 517, 12 528, 12 561, and 12 572 are not possible. Thus, the smallest possibility is 12 539.
The final condition for a Sorrol number is that $bcd = b5d$ is divisible by 3, and so the sum of the digits $b + 5 + d$ is a multiple of 3.
Since $2 + 5 + 3 = 10$ is not a multiple of 3, then 12 539 is not a Sorrol number.
The next smallest possibility is 12 583.
In this case, $2 + 5 + 8 = 15$ is a multiple of 3, and so 12 583 is the smallest Sorrol number.

Next, we determine the largest Sorrol number.
The largest five-digit integers $abcde$ with different digits have $a = 9$ and $b = 8$.
Since the digits must be different, then 98 594, 98 583, 98 539, and 98 528 are not possible. Thus, the largest possibility is 98 572.
However, $8 + 5 + 7 = 20$ is not divisible by 3.
Similarly, 98 561 and 98 517 do not satisfy the divisibility by 3 condition.
The next largest five-digit integers $abcde$ have $a = 9$ and $b = 7$.
In this case, the largest possibility is 97 583 (since 97 594 does not have distinct digits), but this does not satisfy the divisibility by 3 condition.
Checking the next largest possibility 97 561 (since 97 572 does not have distinct digits), we get $7 + 5 + 6 = 18$ which is divisible by 3, and so 97 561 is the largest Sorrol number.
The positive difference between the largest Sorrol number and the smallest Sorrol number is $97\,561 - 12\,583 = 84\,978$.

Answer: (A)

25. There are 9 non-lettered squares that do not share an edge with a lettered square. In the grid shown, each of these squares has been labelled with a 0.

Also, there are 8 non-lettered squares that share an edge with exactly one lettered square. In the grid shown, each of these squares has been labelled with a 1.

Finally, there are 4 non-lettered squares that share an edge with exactly two lettered squares. In the grid shown, each of these squares has been labelled with a 2.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Four or fewer of the numbered squares are to be shaded in. There is no single numbered square that shares a side with all four lettered squares, so at least two numbered squares must be shaded.

We proceed to count the number of ways to shade the grid by considering the following three cases: exactly two squares are shaded, exactly three squares are shaded, and exactly four squares are shaded.

Case 1: Exactly two of the numbered squares are shaded

Shading the two 2s in the middle row is one way to shade the grid, as shown.

Shading the two 2s in the middle column is a second way to shade the grid. These are the only possible ways to shade the grid with exactly two shaded squares.

In Case 1, there are 2 ways to shade the grid.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Case 2: Exactly three of the numbered squares are shaded

We break this case into four subcases by considering the number of squares labelled 2 that are shaded.

Subcase 2a: No square labelled 2 is shaded

If no square labelled 2 is shaded, then each of the three shaded squares must be labelled 0 or 1. It is not possible to shade three of the squares labelled with 0s or 1s while satisfying the condition that each of the four lettered squares shares a side with exactly one shaded square. (You should confirm this for yourself before reading on.)

In Subcase 2a, there are 0 ways to shade the grid.

Subcase 2b: Exactly one square labelled 2 is shaded

There are 4 choices for which square labelled 2 to shade.

This square shares a side with exactly two lettered squares, and so the remaining two shaded squares must each be labelled 1.

For each choice of the square labelled 2, how many choices exist for the two squares labelled 1?

To answer this question, consider the following example. Suppose that the square labelled 2 between the A and B is shaded, as shown. The two squares labelled 1 that share an edge with A cannot be shaded (since A already shares an edge with a shaded square). Similarly, the two squares labelled 1 that share an edge with B cannot be shaded.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Square C does not share an edge with a shaded square, and so one of the two squares labelled 1 that share an edge with C must be shaded. There are 2 choices here.

Similarly, one of the two squares labelled 1 that share an edge with D must be shaded. There are 2 choices here. For each of the possible choices, no shaded square shares an edge with another shaded square.

Thus for each of the 4 choices of the square labelled 2, there are 2×2 choices for the two squares labelled 1, by the symmetry of the lettered and numbered squares within the grid.
Thus, in Subcase 2b, there are $4 \times 2 \times 2 = 16$ ways to shade the grid. One possible way to shade the grid is shown here.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Subcase 2c: Exactly two squares labelled 2 are shaded

As was shown in Case 1, there are 2 possible ways that two squares labelled 2 can be shaded.
For each of these possibilities, the remaining shaded square must be labelled 0.
Of the 9 squares labelled 0, 3 of these share an edge with at least one of the shaded squares labelled 2 (these are the 0s that are in the same row or column as the 2s).
Thus, for each of the 2 choices for the two squares labelled 2, there are $9 - 3 = 6$ choices for the remaining square labelled 0.
For each of the possible choices, no shaded square shares an edge with another shaded square.
Thus in Subcase 2c, there are $2 \times 6 = 12$ ways to shade the grid.
One possible way to shade the grid is shown here.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Subcase 2d: Exactly three squares labelled 2 are shaded

All possible choices of shading three squares labelled 2 result in two lettered squares sharing a side with two shaded squares.
Thus in Subcase 2d, there are 0 ways to shade the grid.

In Case 2, there are a total of $16 + 12 = 28$ ways to shade the grid.

Case 3: Exactly four of the numbered squares are shaded

Similar to Case 2, we break this case into subcases by considering the number of squares labelled 2 that are shaded. As in Subcase 2d, it is not possible to shade three or more squares labelled 2.

Subcase 3a: No square labelled 2 is shaded

If no square labelled 2 is shaded, then each of the four shaded squares must be labelled 1.
Each of the 2 squares labelled 1 that share an edge with the A can be shaded.
Similarly, there are 2 squares labelled 1 that share an edge with each of B, C and D that can be shaded.
For each of the possible choices, no shaded square shares an edge with another shaded square.
Thus in Subcase 3a, there are $2 \times 2 \times 2 \times 2 = 16$ ways to shade the grid. One possible way to shade the grid is shown here.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Subcase 3b: Exactly one square labelled 2 is shaded

With exactly one shaded square labelled 2, two squares labelled 1 must be shaded, and one square labelled 0 must be shaded.
As was shown in Subcase 2b, for each of the 4 choices of the square labelled 2, there are $2 \times 2 = 4$ ways for the two squares labelled 1 to be shaded.
The number of choices of the square labelled 0 is dependent on how the two squares labelled 1 are shaded.
For example, suppose that the square labelled 2 between the A and the B is shaded.
Then, the 4 ways to shade the squares labelled 1 are shown in the four figures below.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Figure 1

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Figure 2

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Figure 3

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

Figure 4

Next, we consider the number of ways to choose the final shaded square labelled 0.
In each of the four figures, the 2 squares labelled 0 that share an edge with the shaded square labelled 2 cannot be shaded.
This leaves $9 - 2 = 7$ choices for the square labelled 0 in each figure.
In Figure 1, there are an additional 4 squares labelled 0 that share an edge with a shaded square labelled 1, leaving $7 - 4 = 3$ choices for the square labelled 0 in this figure.
Thus in Figure 1, there are 3 ways to choose the remaining squares. Similarly, there are 3 ways to choose the remaining squares in Figure 2 and Figure 3, and so there are $3 + 3 + 3 = 9$ ways to choose the squares.
In Figure 4, there are only 3 squares labelled 0 that share an edge with a shaded square labelled 1, leaving $7 - 3 = 4$ choices for the square labelled 0 in this figure.
Thus, for this choice of the square labelled 2, there are 4 ways to choose the remaining squares in Figure 4.
Thus, for this choice of the square labelled 2, there are $9+4 = 13$ ways to choose the remaining squares.
Again by symmetry, the counting shown for this example is the same for each of the 4 possible choices of the square labelled 2, and so in Subcase 3b, there are $4 \times 13 = 52$ ways to shade the grid.

<u>Subcase 3c:</u> Exactly two squares labelled 2 are shaded

With exactly two shaded squares labelled 2, the remaining two shaded squares must be labelled 0.
There are 2 ways to choose the two shaded squares labelled 2.
For each of these choices, there are 3 squares labelled 0 that share an edge with a shaded square, and so there are $9 - 3 = 6$ squares labelled 0 from which to choose two.
For each of the possible choices, no shaded square shares an edge with another shaded square.
There are 6 ways to choose the first square labelled 0, followed by 5 ways to choose the second square labelled 0. However, this double counts the number of possibilities since choosing, for example, the 0 in the top left corner followed by the 0 in the top right corner, is the same pair of squares that we get when choosing them in the reverse order.
Thus, the number of ways to choose two squares labelled 0 is
$\dfrac{6 \times 5}{2} = 15$.
In Subcase 3c, there are $2 \times 15 = 30$ ways to shade the grid.
One possible way to shade the grid is shown here.

0	1	0	1	0
1	A	2	B	1
0	2	0	2	0
1	C	2	D	1
0	1	0	1	0

In Case 3, there are a total of $16 + 52 + 30 = 98$ ways to shade the grid.

Having considered all possible cases, there are a total of $2 + 28 + 98 = 128$ ways to shade the grid.

Answer: (E)

Grade 8

1. In a list of numbers, the mode is the number that occurs most frequently.
   Thus, the mode in the given list of numbers is 2.

   Answer: (A)

2. After Liliana gives Abigail \$4, she still owes her $\$11 - \$4 = \$7$.

   Answer: (D)

3. The perimeter is 12 cm. Thus, $3\text{ cm} + 5\text{ cm} + x\text{ cm} = 12\text{ cm}$, and so $x = 12 - 8 = 4$.

   Answer: (C)

4. There are 60 seconds in 1 minute. The faucet drips at a rate of 1 drop every 10 seconds and so, $\frac{60}{10} = 6$ drops will fall in 1 minute.

   Answer: (E)

5. The distance between 0 and 4 along the number line is 4.
   The tick marks divide this distance into 16 equal lengths, and so the distance between adjacent tick marks is $\frac{4}{16} = 0.25$.
   The number T is 3 tick marks to the right of 0, and thus the value of T is $3 \times 0.25 = 0.75$.

   Answer: (C)

6. The measure of each of the three angles in an equilateral triangle is $\frac{180^\circ}{3} = 60^\circ$.
   Thus, $\angle RSU = \angle TSU = 60^\circ$.
   Since $\angle RST = \angle RSU + \angle TSU$, then the measure of $\angle RST = 60^\circ + 60^\circ = 120^\circ$.

   Answer: (D)

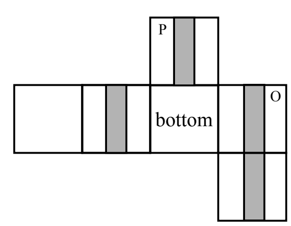
7. The total number of students surveyed was $10 + 5 + 9 + 6 = 30$.
   Of the 30 students surveyed, 6 students arrive by car.
   Thus, the percentage of students that get to school by car is $\frac{6}{30} \times 100\% = \frac{1}{5} \times 100\% = 20\%$.

   Answer: (C)

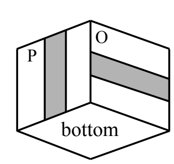
8. Each digit of Livy's code is a different integer from 0 to 9 inclusive, meaning that there are 10 possible digits.
   Since each digit of the code is different, Livy knows that the last digit of the code is not equal to one of the first 3 digits. This leaves $10 - 3 = 7$ possible digits from which Livy will choose the last digit. The probability that Livy will choose the correct last digit from these 7 on her first try is $\frac{1}{7}$.

   Answer: (B)

9. The net shown in (B) could not be the net of the cube.
   Using the net in (B), we begin by labelling three squares "bottom", "O" and "P", as shown.
   We then fold the net so that the face labelled bottom is the bottom face of the cube, and the two faces labelled O and P, folded upward, become two adjacent vertical faces of the cube.

   The bottom of the cube, along with the two folded vertical faces are shown in the second diagram.
   We ignore the other three faces of the cube, since the faces labelled O and P are sufficient for demonstrating that the net in (B) cannot be folded to give the required band around the cube.

   Answer: (B)

10. The first three even integers in the list are $2 = 2 \times 1$, $4 = 2 \times 2$, and $6 = 2 \times 3$.
Each even integer in the list is of the form $2 \times n$ where n is a positive integer.
Thus, the 15th even integer is $2 \times 15 = 30$.
The first three odd integers in the list are each one less than the first three even integers in the list, respectively. These are $1 = 2 \times 1 - 1$, $3 = 2 \times 2 - 1$, and $5 = 2 \times 3 - 1$.
Each odd integer in the list is of the form $2 \times n - 1$ where n is a positive integer.
Thus, the 25th odd integer is $2 \times 25 - 1 = 49$.
The result of subtracting the 15th even integer from the 25th odd integer is $49 - 30 = 19$.

ANSWER: (C)

11. Since $p + q + r = p + r + q = 19$ and $p + r = 8$, then $8 + q = 19$ and so $q = 19 - 8 = 11$.

ANSWER: (B)

12. Brock is seated in the chair between Abel and Duan, as shown in Figure 1.
Edith is not beside Duan, and thus must be beside Abel, as shown in Figure 2.
Callie must be seated in the final seat. Therefore, Abel and Callie are seated to Edith's immediate left and right, as shown in Figure 3.
Confirm for yourself that switching the positions of Abel and Duan in each figure results in Edith and Callie switching positions in Figure 3, but does not change the final result.

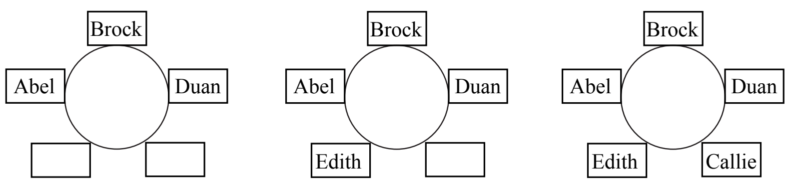


Figure 1 Figure 2 Figure 3

ANSWER: (A)

13. The mass of a serving tray is 4 times the mass of a plate, and so the combined mass of a tray and 6 plates is equivalent to the mass of $4 + 6 = 10$ plates.
If the mass of 10 plates is 3000 g, then the mass of each plate is $\frac{3000 \text{ g}}{10} = 300$ g.

ANSWER: (E)

14. *Solution 1*
Each hour, Anna jogs 6 km and Yao jogs 8 km, and so combined they jog $6 \text{ km} + 8 \text{ km} = 14$ km.
After 2 hours, they combine to jog $2 \times 14 \text{ km} = 28$ km, and after 3 hours, they combine to jog $3 \times 14 \text{ km} = 42$ km.
Since they started 42 km apart, then after 3 hours they meet. After 3 hours, Anna has jogged $3 \text{ h} \times 6 \text{ km/h} = 18$ km, Yao has jogged $3 \text{ h} \times 8 \text{ km/h} = 24$ km, and so Yao has travelled $24 \text{ km} - 18 \text{ km} = 6$ km farther than Anna.

Solution 2
Anna jogs at 6 km/h and Yao jogs at 8 km/h, and so they are moving toward one another at a constant rate of $6 \text{ km/h} + 8 \text{ km/h} = 14$ km/h.
Thus combined Anna and Yao will travel 42 km, and meet after $\frac{42 \text{ km}}{14 \text{ km/h}} = 3$ hours.
Since Yao jogs $8 \text{ km/h} - 6 \text{ km/h} = 2$ km/h faster than Anna jogs, then Yao travels $2 \text{ km/h} \times 3 \text{ h} = 6$ km farther than Anna.

ANSWER: (A)

15. Half of the stack, or 25 cm, is removed from the stack and so 25 cm remains in the stack.
Of the 25 cm removed, $\frac{1}{5} \times 25$ cm $= 5$ cm are put back onto the stack.
The final height of the stack is 25 cm + 5 cm = 30 cm.

ANSWER: (C)

16. Using the Pythagorean Theorem, we get $x^2 + x^2 = \sqrt{8}^2$ or $2x^2 = 8$. So, $x^2 = 4$ or $x = 2$ (since $x > 0$).
Thus, the right-angled isosceles triangle has area $\frac{1}{2} \times 2 \text{ cm} \times 2 \text{ cm} = 2 \text{ cm}^2$.
A square with side length 8 cm has area $8 \text{ cm} \times 8 \text{ cm} = 64 \text{ cm}^2$.
Thus, the smallest number of these triangles needed to completely cover the square is $\frac{64 \text{ cm}^2}{2 \text{ cm}^2} = 32$.

ANSWER: (D)

17. Since $P4R$ is a three-digit integer, then $P \neq 0$.
If $P > 2$, then $P + 7 > 9$ and so $T > 9$. In this case, $TU1$ would be a four-digit integer which is not possible, and so $P = 2$.
In the hundreds column $P + 7 = 2 + 7 = 9$.
So, there can be no carry from the tens column to the hundreds column for the same reason as just described, and thus $T = 9$. The remaining digits are 0, 3, 5, 8.
The ones (units) digit of the sum is 1, and so the only possibilities for R and S are 3 and 8, in some order.
Since $3 + 8 = 11$, there is a carry of 1 from the ones column to the tens column.
Thus, the sum in the tens column is $1 + 4 + Q = 5 + Q$.
Since there is no carry from the tens column to the hundreds column, then $5 + Q = U$, which gives $Q = 0$ and $U = 5$.
The two possible sums are shown on the right.

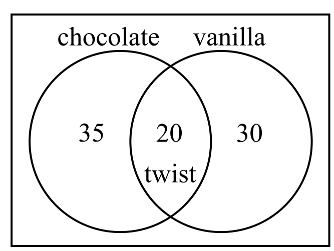
$$\begin{array}{rr} & P4R \\ + & 7QS \\ \hline & TU1 \end{array}$$

$$\begin{array}{rr} & 243 \\ + & 708 \\ \hline & 951 \end{array}$$

$$\begin{array}{rr} & 248 \\ + & 703 \\ \hline & 951 \end{array}$$

ANSWER: (D)

18. Of all 85 cones sold, $\frac{11}{17} \times 85 = 55$ cones contained some chocolate.
Of all 85 cones sold, $\frac{10}{17} \times 85 = 50$ cones contained some vanilla.
The total $55 + 50 = 105$ is more than the number of cones (85) because it counts each twist cone exactly twice. Thus, $105 - 85 = 20$ must equal the number of twist cones. That is, 20 cones were twist, $55 - 20 = 35$ cones were chocolate, and $50 - 20 = 30$ cones were vanilla, as shown in the Venn diagram.



ANSWER: (E)

19. The distance between two parallel lines is constant. Thus, the height of parallelogram $ABFE$ is equal to the height of $\triangle CDG$.
Suppose that height is h. In this case, the ratio of the area of $ABFE$ to the area of $\triangle CDG$ is $AB \times h : \frac{1}{2} \times CD \times h$.
Substituting and simplifying, this ratio is equal to $8 \times h : \frac{1}{2} \times 12 \times h = 8 : 6 = 4 : 3$.

ANSWER: (E)

20. Written as a mixed fraction, $\frac{90}{11} = 8\frac{2}{11}$, and so $a + \frac{1}{b+\frac{1}{c}} = 8 + \frac{2}{11}$.
If $a = 8$, then $\frac{1}{b+\frac{1}{c}} = \frac{2}{11}$.
Since $\frac{2}{11}$ has numerator 2, we rewrite the previous equation as $\frac{2 \times 1}{2 \times \left(b + \frac{1}{c}\right)} = \frac{2}{11}$.
Both numerators are now equal to 2, and so $2 \times \left(b + \frac{1}{c}\right) = 11$ or $b + \frac{1}{c} = \frac{11}{2}$.
Written as a mixed fraction, $\frac{11}{2} = 5\frac{1}{2}$, and so $b + \frac{1}{c} = 5 + \frac{1}{2}$.
If $b = 5$, then $\frac{1}{c} = \frac{1}{2}$, and so $c = 2$.
Therefore, $a + \frac{1}{b+\frac{1}{c}} = 8 + \frac{1}{5+\frac{1}{2}}$ and $a + b + c = 8 + 5 + 2 = 15$.

Answer: (D)

21. *Solution 1*
We assign each of r, s and t a different number from the list 3, 4, 5, and then determine the value of $r \times s + t$ for each possibility.
If $r = 3$, $s = 4$ and $t = 5$, then $r \times s + t = 3 \times 4 + 5 = 17$, which is odd.
If $r = 3$, $s = 5$ and $t = 4$, then $r \times s + t = 3 \times 5 + 4 = 19$, which is odd.
If $r = 4$, $s = 3$ and $t = 5$, then $r \times s + t = 4 \times 3 + 5 = 17$, which is odd.
If $r = 4$, $s = 5$ and $t = 3$, then $r \times s + t = 4 \times 5 + 3 = 23$, which is odd.
If $r = 5$, $s = 3$ and $t = 4$, then $r \times s + t = 5 \times 3 + 4 = 19$, which is odd.
If $r = 5$, $s = 4$ and $t = 3$, then $r \times s + t = 5 \times 4 + 3 = 23$, which is odd.
We have considered all possible ways to assign the values 3, 4 and 5, and so there are 6 such ways for which $r \times s + t$ is odd.

Solution 2
First, recognize that both 3 and 5 are odd, and 4 is even.
When each of r, s and t is assigned a different number from the list 3, 4, 5, then either r and s are both odd, or exactly one of r and s is odd.
If r and s are both odd, then $r \times s$ is odd and $t = 4$, and so $r \times s + t$ is odd.
If exactly one of r and s is odd, then $r \times s$ is even and t is odd, and so $r \times s + t$ is odd.
Thus, the value of $r \times s + t$ is always odd.
When assigning the values 3, 4, 5, there are 3 choices for the value of r, followed by 2 choices for the value of s, and then 1 choice for the value of t.
Since $r \times s + t$ is odd for all such choices, then there are $3 \times 2 \times 1 = 6$ such ways to assign the numbers.

Answer: (E)

22. The area of $DMBN$ is equal to the sum of the areas of triangles DMB and DNB, and so we will first find these two areas.
Each of DA, DB and DC is a radius of the circle, and so $DA = DB = DC = 5$.
Since $\triangle DAB$ is an isosceles triangle and M is the midpoint of AB, then DM is perpendicular to AB (DM is the height of $\triangle DAB$).
Using the Pythagorean Theorem in $\triangle DMB$, we get $DB^2 = DM^2 + MB^2$ and since $MB = \frac{AB}{2} = 2$ cm, then $5^2 = DM^2 + 2^2$.
Solving for DM, we get $DM^2 = 25 - 4 = 21$, and so $DM = \sqrt{21}$ cm (since $DM > 0$).

Therefore, the area of $\triangle DMB$ is $\frac{1}{2} \times MB \times DM = \frac{1}{2} \times 2 \text{ cm} \times \sqrt{21} \text{ cm} = \sqrt{21} \text{ cm}^2$.
We can similarly determine the area of $\triangle DNB$.
Since $NB = \frac{1}{2} \times BC = 3$ cm, then $5^2 = DN^2 + 3^2$.
Solving for DN, we get $DN^2 = 25 - 9 = 16$, and so $DN = \sqrt{16} = 4$ cm (since $DN > 0$).
Therefore, the area of $\triangle DNB$ is $\frac{1}{2} \times NB \times DN = \frac{1}{2} \times 3 \text{ cm} \times 4 \text{ cm} = 6 \text{ cm}^2$.
Adding the two areas together, the area of $DMBN$ is $\sqrt{21} \text{ cm}^2 + 6 \text{ cm}^2$, which is 10.6 cm^2 when rounded to one decimal place.

ANSWER: (B)

23. The probability that the second roll is a 2 is equal to the probability that the first roll is odd and the second roll is a 2, added to the probability that the first roll is even and the second roll is a 2.
The original die has 2 odd numbers and 4 even numbers on its faces. Thus the probability that the first roll is odd is $\frac{2}{6}$, and the probability that the first roll is even is $\frac{4}{6}$.
If the first roll is odd, the numbers on the faces are changed to 2, 2, 2, 4, 14, 8.
In this case, the probability that the second roll is a 2 is $\frac{3}{6}$, and so the probability that the first roll is odd and the second roll is 2 is $\frac{2}{6} \times \frac{3}{6} = \frac{6}{36}$.
If the first roll is even, the numbers on the faces are changed to 1, 1, 1, 2, 7, 4.
In this case, the probability that the second roll is a 2 is $\frac{1}{6}$, and so the probability that the first roll is even and the second roll is 2 is $\frac{4}{6} \times \frac{1}{6} = \frac{4}{36}$.
Thus, the probability that the second roll is a 2 is equal to $\frac{6}{36} + \frac{4}{36} = \frac{10}{36} = \frac{5}{18}$.

ANSWER: (D)

24. Suppose that when Serafine and Jamie stop playing catch, they have a total of c catches and m misses.
Each catch increases the distance between them by 2×60 cm $= 120$ cm, and so c catches increases the distance between them by $120c$ cm.
Each miss decreases the distance between them by 20 cm, and so m misses decreases the distance between them by $20m$ cm.
They begin 1500 cm apart and when they stop they are 1720 cm apart, and so $1500 + 120c - 20m = 1720$.
Simplifying this equation, we get $120c - 20m = 1720 - 1500$ or $120c - 20m = 220$. Dividing each term by 20, we get $6c - m = 11$.
Since the question asks which number of throws is not possible, then we let the number of throws be n, and so $n = m + c$.

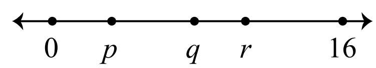
With $6c - m = 11$ and $n = m + c$, we get the following equivalent equations

$$\begin{aligned} 6c - m &= 11 \\ 6c &= 11 + m \\ 6c + c &= 11 + m + c \\ 7c &= 11 + n \end{aligned}$$

and so $n = 7c - 11$.
If $n = 21$, then $7c - 11 = 21$ or $7c = 32$, and so $c = \dfrac{32}{7}$. However, $\dfrac{32}{7}$ is not an integer and so 21 throws is not possible.
We can confirm that when c is equal to 4, 12, 8, and 3, then the number of throws, $n = 7c - 11$, is equal to 17, 73, 45, and 10, respectively.
In each case, $m = 6c - 11$ and so m is also a positive integer.
Of the given possibilities, 21 throws is not possible.

ANSWER: (B)

25. Suppose the five distinct points are placed on a number line with the leftmost point at 0.
The largest distance between a pair of these five points is 16 (since $n < 16$), and so the rightmost point appears on the number line at 16.
Next, we place the remaining three points on the number line at the values p, q and r, where $0 < p < q < r < 16$, as shown.



Since the ten distances between pairs of points are integers, then each of p, q and r is an integer.
The ten distances between pairs of points are:

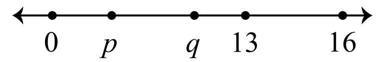
$$p - 0 = p,\ q - 0 = q,\ r - 0 = r,\ 16 - 0 = 16,\ q - p,\ r - p,\ 16 - p,\ r - q,\ 16 - q,\ 16 - r$$

Of the given distances, 2, 3, 4, 5, 7, 9, 11, 13, 16, n, we have accounted for the distance 16 by fixing endpoints at 0 and 16, and so we may ignore this distance going forward.
The problem remains to determine all possible values of p, q, r for which the distances $p, q, r, q - p, r - p, r - q, 16 - p, 16 - q, 16 - r$ (in some order) match the distances 2, 3, 4, 5, 7, 9, 11, 13, n for some integer n, where $1 \leq n \leq 15$.

It is not possible for each of the values p, q and r to equal 1, 6, 8, 10, or 15. Why? If for example $p = 1$, then $16 - p = 15$. In this case, 1 and 15 are two distances not in the list 2, 3, 4, 5, 7, 9, 11, 13. Since there is one unknown distance, n, then there can be at most one distance not in the list 2, 3, 4, 5, 7, 9, 11, 13. This tells us that 1 is not a possible value of p, q or r.
Using this same argument, we can show that 6, 8, 10, and 15 are also not possible values of p, q and r.

Next, we show that exactly one of p, q and r is equal to 3 or 13.
To get a distance of 13, we need points at both 0 and 13, or at both 1 and 14, or at both 2 and 15, or at both 3 and 16.
We have shown that 1 and 15 are not possible values of p, q and r, and so the middle two possibilities are not permitted.
Thus, at least one of p, q and r is equal to 3 or 13.
If two of p, q and r are equal to 3 and 13, then the distances 3 and 13 would each appear twice in the list (since $16 - 3 = 13$ and $16 - 13 = 3$), which is not possible.
It follows that exactly one of p, q and r is equal to 3 or 13.
Let us assume that exactly one of p, q and r is equal to 13. We will deal with the possibility

that one of p, q and r is equal to 3 at the end of the solution.
Suppose that $q = 13$. Then $r = 14$ since we have shown that r cannot equal 15.
However, if $r = 14$, then $r - q = 14 - 13 = 1$, but both 1 and 14 are not in the list of distances, so this is not possible.
Similarly, we can show that $p \neq 13$, and so $r = 13$, as shown.



With $r = 13$, we get $16 - r = 3$, and so the remaining distances are 2, 4, 5, 7, 9, 11, n, and the work above establishes that all remaining distances are less than 13, and thus $n \leq 12$.
With $r = 13$, we have shown that p and q cannot be equal to $1, 3, 6, 8, 10, 13, 14$ and 15. The possible values of p and q are thus, 2, 4, 5, 7, 9, 11, and 12.
If $p = 2$, then $16 - p = 14$ and since 14 is not in the list of distances and $n \neq 14$, then $p \neq 2$.
If $q = 12$, then $q - 0 = 12$ and $r - q = 13 - 12 = 1$ are two values not in the list of distances, and so $q \neq 12$.
Since $q \leq 11$ and $p < q$, then $p \neq 11$. The remaining possible values of p are 4, 5, 7, 9.
Since $p \geq 4$ and $p < q$, then $q \neq 4$. The remaining possible values of q are 5, 7, 9, 11.
This gives 10 possible pairs of values (p, q). These are: $(4, 5)$, $(4, 7)$, $(4, 9)$, $(4, 11)$, $(5, 7)$, $(5, 9)$, $(5, 11)$, $(7, 9)$, $(7, 11)$, and $(9, 11)$.
In each case, $r = 13$.
Recall that the remaining distances are 2, 4, 5, 7, 9, 11, and n.
If $(p, q) = (4, 5)$, then $q - p = 5 - 4 = 1$ and $16 - q = 16 - 5 = 8$ are two distances not listed and so $(p, q) \neq (4, 5)$. We continue our analysis of the remaining 9 pairs in the table that follows.

(p, q)	Distance(s) not included in 2, 4, 5, 7, 9, 11	Value of n?
$(4, 5)$	$q - p = 1$ and $13 - q = 8$	not possible
$(4, 7)$	$q - p = 3$ and $13 - q = 6$	not possible
$(4, 9)$	$16 - p = 12$ and $p - 0 = 13 - q = 4$ (gives two 4s)	not possible
$(4, 11)$	$16 - p = 12$	$n = 12$
$(5, 7)$	$13 - p = 8$ and $13 - q = 6$	not possible
$(5, 9)$	$13 - p = 8$ and $q - p = 13 - q = 4$ (gives two 4s)	not possible
$(5, 11)$	$13 - p = 8$ and $q - p = 6$	not possible
$(7, 9)$	$13 - p = 6$ and $q - 0 = 16 - p = 9$ (gives two 9s)	not possible
$(7, 11)$	$13 - p = 6$	$n = 6$
$(9, 11)$	$13 - q = q - p = 2$ (gives two 2s)	$n = 2$

Thus, the possible values of n are 2, 6, 12, and so there are 3 possible values of n.

Note: Earlier in the solution we made the assumption that one of p, q and r was equal to 13, and then showed that $r = 13$. We could have similarly assumed that one of p, q and r was equal to 3, and then showed that $p = 3$.
Notice that having $r = 13$ is symmetrical to having $p = 3$.
That is, when $r = 13$ we get the two distances $r - 0 = 13$ and $16 - r = 3$. When $p = 3$, we get the same two distances $p - 0 = 3$ and $16 - p = 13$. The solution was shortened by taking advantage of this symmetrical property of the values p, q and r. Specifically, the reflection of the values p, q, r, that is, changing each of these to $16 - p$, $16 - q$, $16 - r$ gives the same set of distances, and thus the same value of n. For example, the reflection of $(0, p, q, r, 16) = (0, 4, 11, 13, 16)$ is $(16 - 0, 16 - p, 16 - q, 16 - r, 16 - 16)$ which is equal to $(16, 12, 5, 3, 0)$ or $(0, 3, 5, 12, 16)$ which gives the same set of distances as $(0, 4, 11, 13, 16)$, and thus also gives $n = 12$.

Answer: (C)