Grade 6 Math Circles

October 24/25/26

BCC Preparation

Beaver Computing Contest

The Beaver Computing Challenge (BCC) is an online problem-solving contest with a focus on computational and logical thinking. No prior coding experience is required. The questions are inspired by topics in computer science but students only require the concepts taught in the mathematics curriculum common to all provinces.

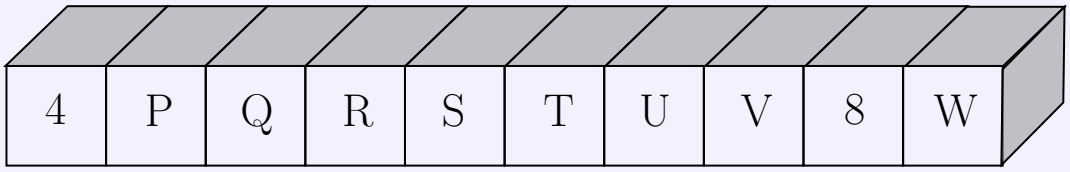
Students in grade 6 or below can write the Grade 5/6 BCC. The Grade 5/6 BCC consists of 12 multiple choice questions divided into 3 parts with 60 marks total: 4 questions in Part A worth 6 marks each, 4 questions in Part B worth 5 marks each, and 4 questions in Part C worth 4 marks each. Students are given exactly 45 minutes to answer the questions. Some calculators are permitted. Each question on the BCC is given by a story and a question. The story provides the background information required to solve the question.

More information on the BCC: https://cemc.uwaterloo.ca/contests/bcc.html
Past contests/solutions: https://www.cemc.uwaterloo.ca/contests/past_contests.html#bcc

Try This!

Exercise 1: Missing Numbers

Consider the boxes below. In each box, there is a number between 1 and 9 (inclusive). However, we only know what numbers are in two of the boxes, the other boxes are labeled with letters. We are given some additional information about the boxes: The numbers in any three consecutive boxes (that is, any three boxes in a row) have a sum of 15.

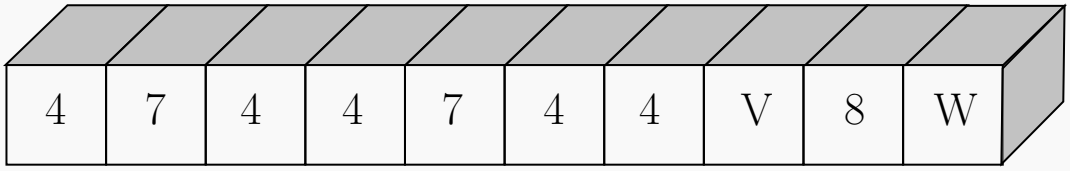


What number is in box S?

Solution

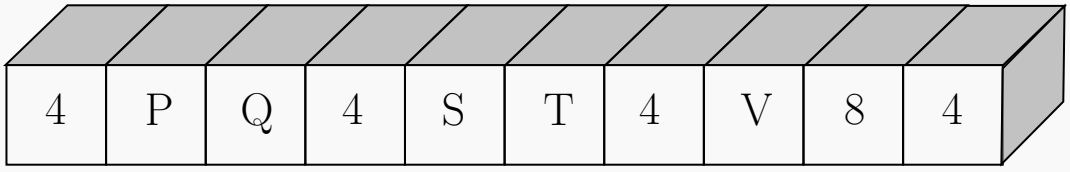
The correct answer is 3. There are many different ways to approach the problem. We'll go through 3 different solutions here.

Solution 1: Guess and check. A common way to try and solve any problem when you're not too sure what to do is to guess a number and see if it works. Suppose you guess that P is 7. We can use the fact that three consecutive boxes add up to 15 to fill in the rest of the boxes to get the following



However, we have a problem when trying to figure out V. We know that $4+4+V=15$, so $V=7$. But at the same time, we know that $4+V+8=15$ so $V=3$. But V can only be one number, so we know we guessed wrong. We could continue guessing numbers until we get one that works, but let's see another approach.

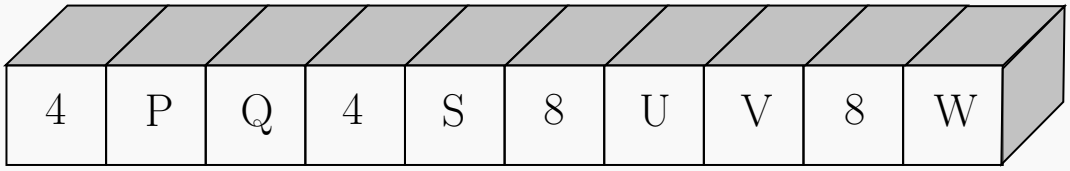
Solution 2: Using the fact that any three consecutive boxes add to 15, we know that $4+P+Q=15$, so $P+Q=11$. We don't know what either P or Q are, but we have the sum. Moving along one box, we know that $P+Q+R=15$, but $P+Q=11$ so $R=4$. We can continue this to get



Then we can work backwards to get $V=3$, $T=8$, and $S=3$. This is much faster than guess

and check, but we can do even better.

Solution 3: In the last solution, we filled in almost every box to find out what S is, but we don't need the other boxes. Again, we know that $4+P+Q=15$ so $P+Q=11$ and thus $R=4$. But we don't only have to work from left to right. We also know that $U+V+8=15$ so $U+V=7$. Then $T+U+V=15$, so $T=8$.



Then we can see $4+S+8=15$ and so $S=3$. This approach saves lots of time.

Contest Strategies

When doing most contests, the length of your solution doesn't matter. In fact, the solution doesn't matter at all in multiple choice contests such as the BCC. This means that whichever solution that you had in the exercise would give you full marks.

However, your speed is what's important on contests! One of the most common reasons that questions are left blank on contests is due to running out of time. This is why it's important to be able to find efficient solutions to problems. While solution 1 was correct, it isn't very efficient. Solution 2 is much more efficient than solution 1, but every minute counts when writing a contest. This is why solution 3 would be the desired solution.

Here are some other strategies that you might find useful when writing the BCC:

- First read the story, then the question, then reread the story. This will help with finding the details needed to solve the question as well as understanding what the question is asking.
- Underline or write down the important information in the story and question.
- If the question is long and/or challenging, split it into pieces or steps. Focus on one step at a time, then connect them all together at the end.
- Make a chart or diagram to help organize what is given in the story. Or create another image that will help to visualize what is happening in the problem.

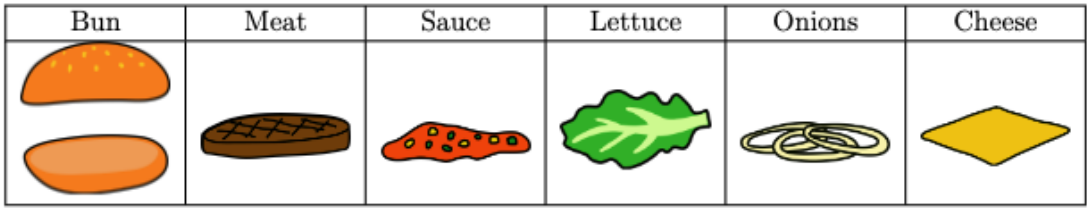
- Rule out answers that are impossible or that you can show aren't the solution. The problems are all multiple choice and will have 4 options, so ruling out a couple incorrect answers can help with deciding on the correct answer. When in doubt, make a logical guess.
- Have fun writing the contest! This contest is meant to be an enjoyable experience that will motivate your interest in math and computer science. The BCC emphasizes participation rather than competition, so be proud of trying. Following the end of the contest window, solutions will be posted on the website at this link: https://www.cemc.uwaterloo.ca/contests/past_contests.html#bcc.

Now, let's take a look at some questions from past contests.

Examples

Story

A hamburger is made using the following six ingredients.



The hamburger is made according to the following three rules.

1. The sauce should be directly on top of the meat.
2. The meat and cheese should be somewhere below the lettuce and onions.
3. The onions should not be in contact with the bun.

Question

Which of the following could be the hamburger?

(A) 

(B) 

(C) 

(D) 

Solution

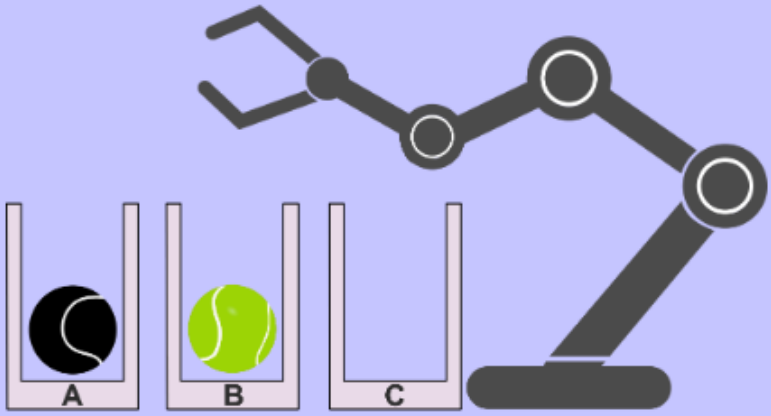
We could check one hamburger at a time, but this might not be very efficient. Instead, let's use process of elimination! The first rule of hamburger making is that the bun should be directly on top of the meat. This eliminates (C) since the sauce is on the cheese.

Rule two is that the meat and cheese should be below the lettuce. This eliminates (B) since the cheese is above the lettuce.

Finally, rule three says that onions should not be in contact with the bun. This eliminates (A) since the onions are touching the top bun. This leaves only (D) left, so (D) must be our answer.

Story

There are three bins, two balls, and a robot arm that can pick up the balls. Originally, one ball is in bin A and another is in bin B. Bin C is empty.



Then the robot arm completes the following steps in the order given:

1. Pick up the ball in bin A and put it in bin C.
2. Pick up the ball in bin B and put it in bin A.
3. Pick up the ball in bin C and put it in bin B.

Question

When the robot arm is finished, which of the following statements is true?

(A) The ball originally in bin A is now in bin B, and the ball originally in bin B is now in bin A.

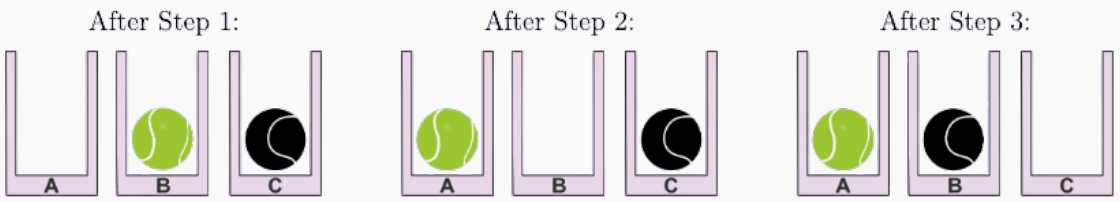
(B) Both balls are in bin A.

(C) Bin A is empty.

(D) Nothing has changed. Each ball is back in its original bin.

Solution

In this question, drawing out each step may be useful.



Now, we can easily see that the answer is (A).

Story

A beaver wants to take a path to the river. Each path passes by three different types of fruit as shown.

The beaver **must** pass by a pineapple which is its favourite fruit.

The beaver **must not** pass by an orange which it is allergic to.

Question

How many of the eight possible paths can the beaver take?

(A) 2

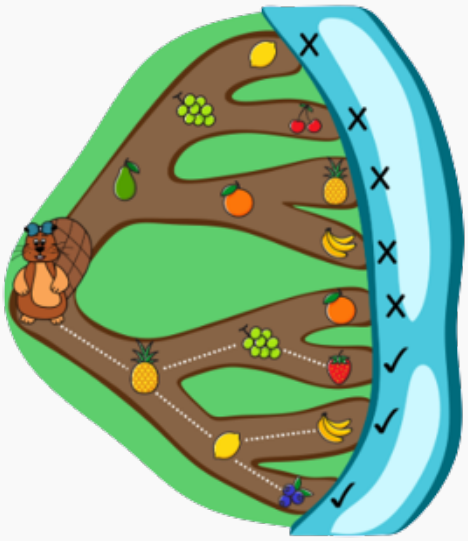
(B) 3

(C) 4

(D) 5

Solution

In this question, we must go through every option. We consider the paths from the top to the bottom of the diagram. The top two paths do not pass by a pineapple. The next three paths pass by an orange. Only the bottom three paths pass by a pineapple but not an orange. Therefore, the answer is (B).



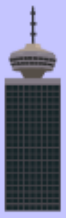
Story

A skyline consists of 14 towers as shown.

The height of a tower is measured from the bottom of its base to its highest point, including any flagpoles or antennas.

Question

If the towers are listed from shortest to tallest, which tower would be 10th in the list?

(A) 

(B) 

(C) 

(D) 

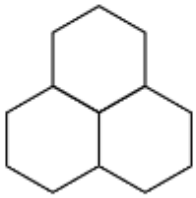
Solution

The correct answer is (A). A common way to solve this problem would be to arrange the towers from shortest to tallest and then pick the 10th tower, or stop arranging the towers when you've placed the 10th tower. However, if we're thinking about efficiency, then notice that since there

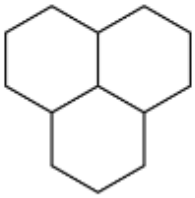
are 14 towers in total, the 10th shortest tower is also the 5th tallest tower. Finding the 5th tallest tower is much faster than finding the 10th shortest tower.

Story

Luis has hexagon pieces in three different colours. Whenever Luis arranges three pieces in a way that resembles an upright triangle, the three pieces must either be *all the same colour*, or *all different colours*. These rules do not apply to other three-piece arrangements. In particular:

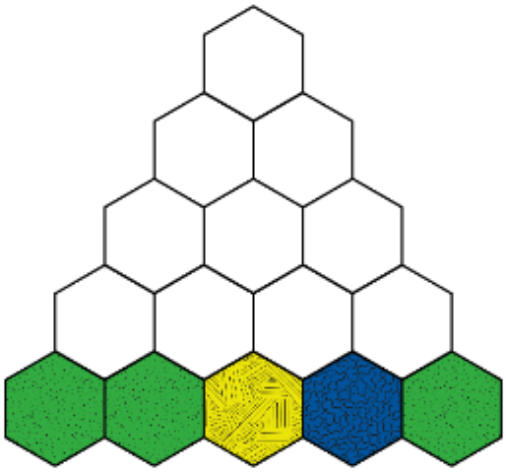


All colours the same
or all colours different



No colour rules

Luis arranges his hexagon pieces in a way that resembles a tower as shown:



Question

Which hexagon piece must be at the very top?

(A) 

(B) 

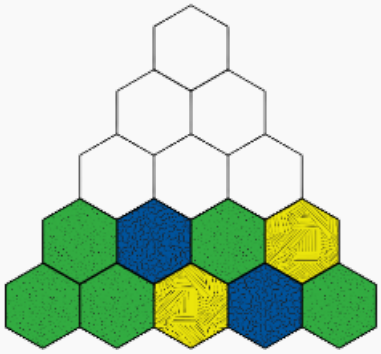
(C) 

(D) There is more than one possibility

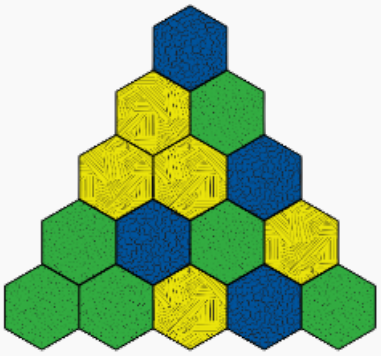
Solution

Once we know the colours of two hexagon pieces beside each other, we can determine the colour of the piece directly above them. If two pieces side-by-side are the same colour, then the piece above them will be that colour also. However, if two pieces side-by-side are different colours, then the piece above them will be neither colour.

Using this idea, the next row up from the bottom will be:



We can continue building the tower from the bottom up until it is complete:



The hexagon piece at the very top is blue.

Story

Beaver homes are identified using symbols rather than digits according to the table shown:

The symbol assigned to a row and the symbol assigned to a column are combined to form a new single symbol. This symbol represents the digit where that row and column meet.

For example, the symbol  represents the digit 5, since it is a combination of its row symbol  and its column symbol  .

Here is a picture of one beaver's home:

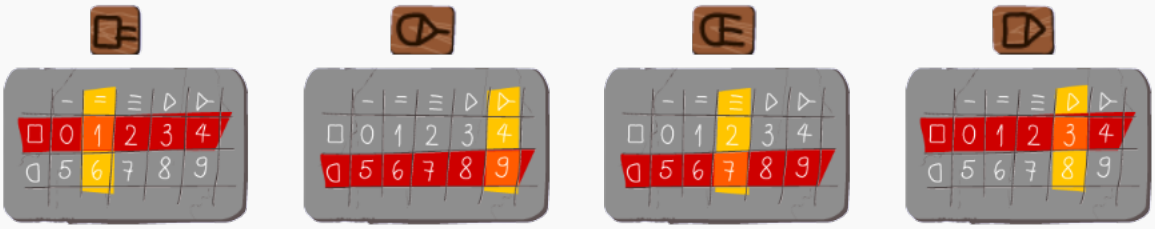
Question

What four-digit number is represented by the symbols on this beaver's home?

(A) 1874
(B) 1923
(C) 1824
(D) 1973

Solution

We could directly check what each symbol on the beaver's home represents, but this would not be the most efficient solution.



All of the answers start with a '1', so there is no need to check the first symbol. If we check the last symbol first, we can eliminate half of the options since they all end in either a 3 or 4. In this case, we end with a 3, so the only options are (B) and (D). The second digit in both of these answers is '9' so there's no need to check the second symbol. Finally, checking the third symbol gives us (D) as the answer.

Story

Here is a line of shapes.

The line has a run of stars of length 2. A *run* is an unbroken chain of identical shapes.

Ali likes to create long runs by changing shapes. For example, if Ali changes the middle square to a star in the line above, then he can create a longer run of length 4.

Question

Suppose Ali chooses and changes exactly 3 of the 16 shapes in the following line:

What is the length of the longest possible run that Ali can create?

(A) 4

(B) 5

(C) 6

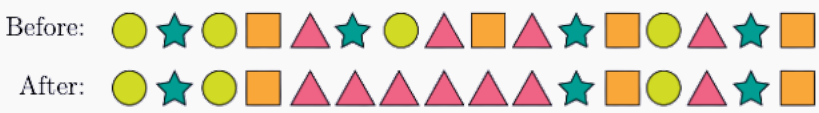
(D) 7

Solution

The correct option is (C). However, to fully justify this, we need to prove two things:

1. that a run of length 6 is possible, and
2. that a run with length greater than 6 is not possible.

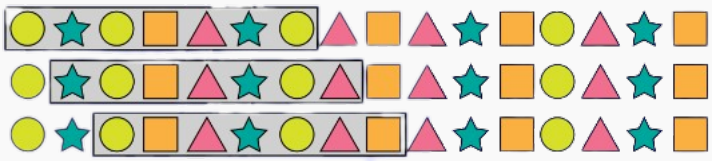
A run of length 6 can be made by changing the second star, third circle, and second square to triangles, as shown.



To prove that a run with length greater than 6 is not possible, consider what it would mean if there was a longer run. It would mean there is a run of length 7. Remember that Ali changes

only 3 shapes. Therefore, any run of length 7 must come from an unbroken chain of length 7 with 4 identical shapes in it.

There are ten unbroken chains of 7 shapes in the original sequence, the first few of which are shown below.



As we can see, none of these unbroken chains of length 7 have 4 identical shapes in them. Convince yourself that this is also true for the remaining unbroken chains of length 7. This means that it is not possible to have a run of length 7.

We have shown there are 6 shapes in the longest possible run.