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1. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

A programmer notices the following two procedures in a library. The procedures do similar, but not identical, things.

- Procedure `Square (n)` returns the value n^2.
- Procedure `Cube (n)` returns the value n^3.

Which of the following procedures is a generalization of the procedures described above?

(A) Procedure `Add (n, m)`, which returns the value $n + m$

(B) Procedure `Fourth (n)`, which returns the value n^4

(C) Procedure `Polynomial(n)`, which returns the value $n^3 + n^2$

(D) Procedure `Power (n, m)`, which returns the value n^m

2. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

An application program interface (API) provides a procedure Max, which returns the greater of its two integer arguments.

A programmer would like to find the greatest of three integer values `a`, `b`, and `c`. Which of the following expressions will produce the desired result in every case?

(A)
```
Max (Max (a, b), c)
```

(B)
```
Max (a, b) - Max (b, c)
```

(C)
```
Max (a, b) + Max (b, c) - Max (a, c)
```

(D)
```
(Max (a, b) + Max (b, c)) / 2
```

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3. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

A program contains the following procedures for string manipulation.

Procedure Call	Explanation
`Concat (str1, str2)`	Returns a single string consisting of `str1` followed by `str2`. For example, `Concat("key", "board")` returns `"keyboard"`.
`Substring (str, start, length)`	Returns a substring of consecutive characters from `str`, starting with the character at position `start` and containing `length` characters. The first character of `str` is located at position `1`. For example, `Substring ("delivery", 3, 4)` returns `"live"`.

Which of the following expressions can be used to generate the string `"Happy"`?

(A) `Concat (Substring ("Harp", 1, 1), Substring ("Puppy", 2, 4))`

(B) `Concat (Substring ("Harp", 1, 2), Substring ("Puppy", 3, 3))`

(C) `Concat (Substring ("Harp", 1, 2), Substring ("Puppy", 4, 2))`

(D) `Concat (Substring ("Harp", 2, 2), Substring ("Puppy", 4, 2))`

4. A programmer is deciding between using a linear or binary search to find a target value in a sorted list. Which of the following is true?

(A) In all cases, a binary search of a sorted list requires fewer comparisons than a linear search.

(B) Generally, the advantage of using a binary search over a linear search increases as the size of the list increases.

(C) A linear search will generally run faster than a binary search because a linear search requires fewer lines of code to implement.

(D) Using a linear search is preferable to using a binary search if there is a chance that the target may not be found in the list.

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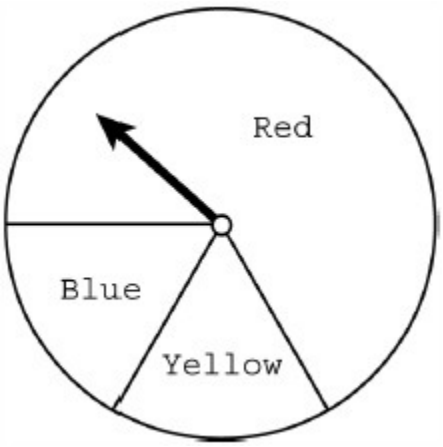
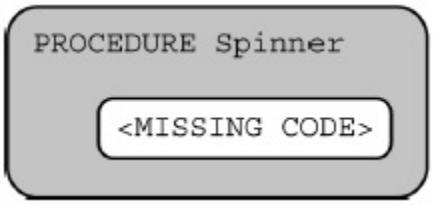
5. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

A spinner is divided into three sections. The sector labeled `Red` is four times as large as each of the sectors labeled `Blue` and `Yellow`, which are of equal size.



The procedure below is intended to simulate the behavior of the spinner.



Which of the following can be used to replace `<MISSING CODE>` so that the procedure correctly simulates the spinner?

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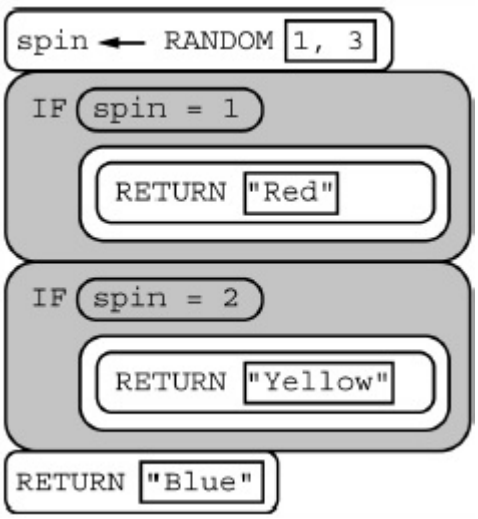
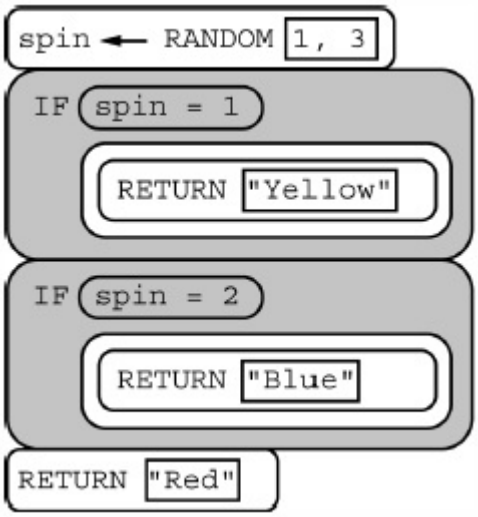
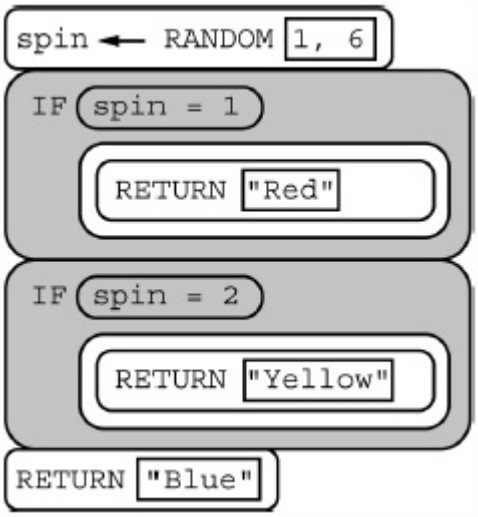
(A)



(B)



(C)



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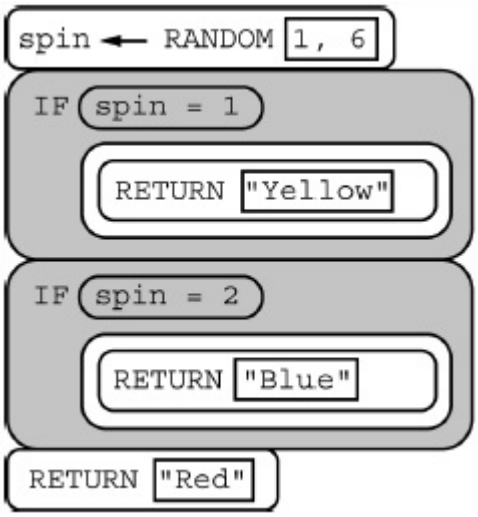
(D)



6. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

A student wrote the procedure below, which is intended to ask whether a user wants to keep playing a game. The procedure does not work as intended.

```
PROCEDURE KeepPlaying ()
{
   DISPLAY ("Do you want to continue playing (y/n)?")
   response ← INPUT ()
   IF ((response = "y") AND (response = "yes"))
   {
      RETURN (true)
   }
   ELSE
   {
      RETURN (false)
   }
}
```

Which of the following best describes the result of running the procedure?

(A) The procedure returns `true` when the user inputs the value `"y"` and returns `false` otherwise.

(B) The procedure returns `true` when the user inputs the value `"n"` and returns `false` otherwise.

(C) The procedure returns `true` no matter what the input value is.

(D) The procedure returns `false` no matter what the input value is.

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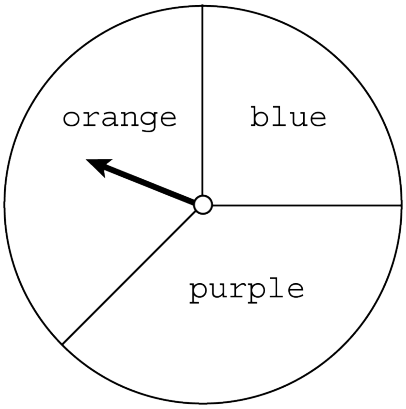
7. The following spinner is used in a game. The region labeled `"blue"` represents $\frac{1}{4}$ of the spinner. The regions labeled `"orange"` and `"purple"` are equal in size.



Which of the following code segments can be used to simulate the behavior of the spinner?

Select two answers.

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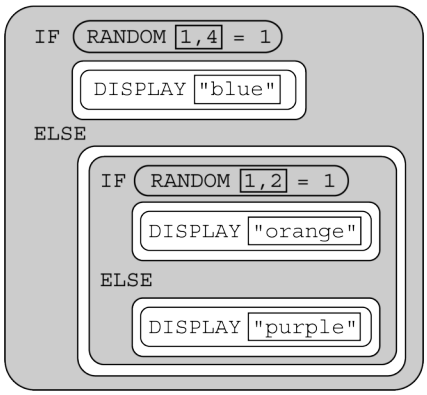
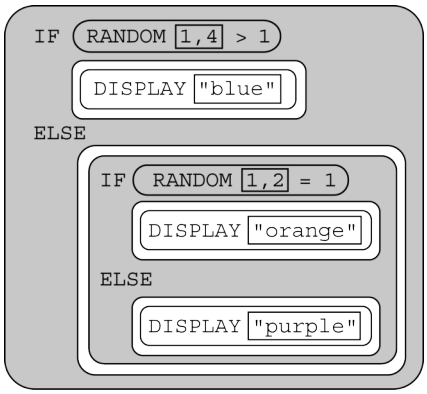
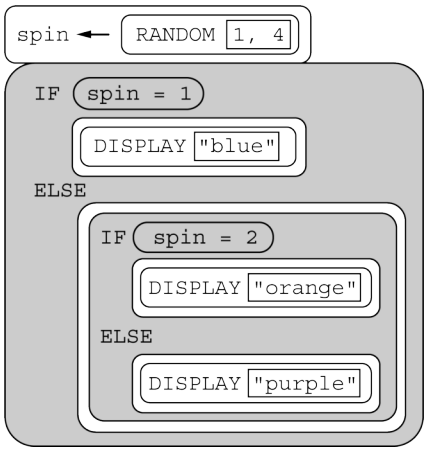
A



B



C



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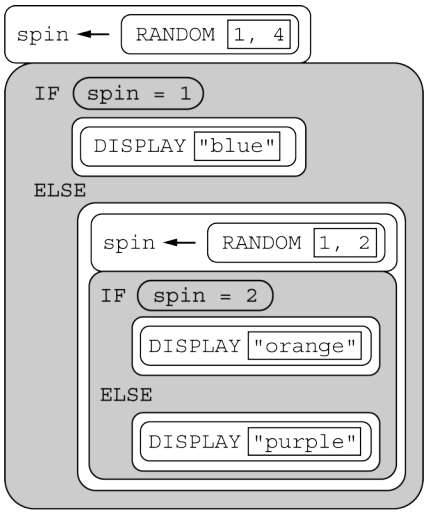
D



8. Which of the following are benefits of procedural abstraction?

Select two answers.

A Procedural abstraction prevents programmers from accidentally using the intellectual property of other programmers.

B Procedural abstraction eliminates the need for programmers to document their code.

C Procedural abstraction makes it easier for people to read computer programs.

D Procedural abstraction provides an opportunity to give a name to a block of code that describes the purpose of the code block.

9. The list `listOne` is a sorted list of numbers that contains 700 elements. The list `listTwo` is a sorted list of numbers that contains 900 elements. Let *x* represent the maximum number of list elements that will need to be examined when performing a binary search for a value in `listOne`, and let *y* represent the maximum number of list elements that will need to be examined when performing a binary search for a value in `listTwo`. Which of the following statements about *x* and *y* is true?

(A) The value of *x* is approximately equal to the value of *y*.

(B) The value of *x* is approximately 10 less than the value of *y*.

(C) The value of *x* is approximately 13 less than the value of *y*.

(D) The value of *x* is approximately 200 less than the value of *y*.

10. A sorted list of numbers contains 200 elements. Which of the following is closest to the maximum number of list elements that will need to be examined when performing a binary search for a particular value in the list?

(A) 5

(B) 8

(C) 100

(D) 200

11. A sorted list of numbers contains 500 elements. Which of the following is closest to the maximum number of list elements that will be examined when performing a binary search for a value in the list?

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(A) 10
(B) 50
(C) 250
(D) 500

12. A sorted list of numbers contains 128 elements. Which of the following is closest to the maximum number of list elements that can be examined when performing a binary search for a value in the list?

(A) 2
(B) 8
(C) 64
(D) 128

13. A time stamp indicates the date and time that a measurement was taken. A data scientist has a list containing 10,000 time stamps, sorted in chronological order. Which of the following is closest to the maximum number of values that will need to be examined when performing a binary search for a value in the list?

(A) 10
(B) 15
(C) 5,000
(D) 10,000

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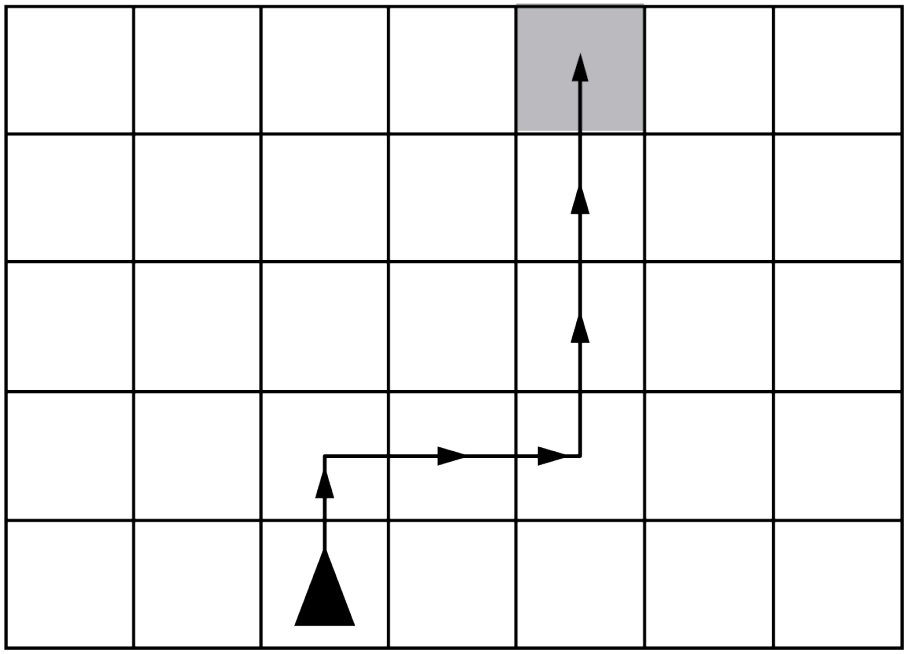
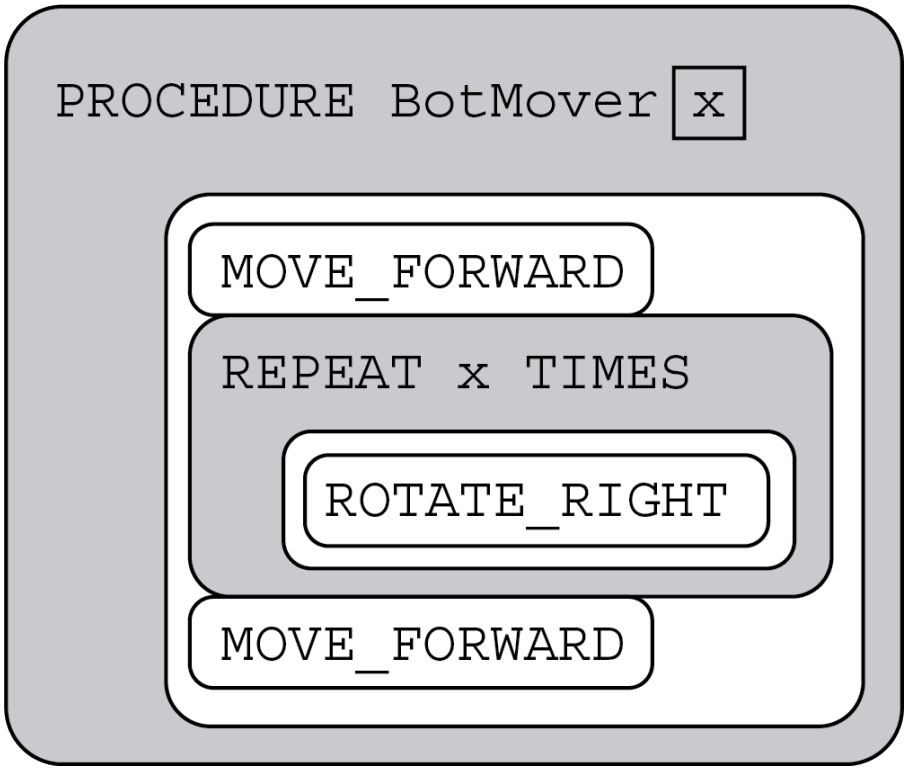
14. The following question uses a robot in a grid of squares. The robot is represented by a triangle, which is initially facing toward the top of the grid.



Consider the procedure below.



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Which of the following code segments will move the robot to the gray square along the path indicated by the arrows?

(A)

```
BotMover 1
BotMover 1
BotMover 0
```

(B)

```
BotMover 1
BotMover 2
BotMover 3
```

(C)

```
BotMover 1
BotMover 3
BotMover 0
```

(D)

```
BotMover 3
BotMover 1
BotMover 0
```

A student's overall course grade in a certain class is based on the student's scores on individual assignments. The course grade is calculated by dropping the student's lowest individual assignment score and averaging the remaining scores.

For example, if a particular student has individual assignment scores of 85, 75, 90, and 95, the lowest score (75) is dropped. The calculated course grade is $(85 + 90 + 95)/3 = 90$.

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15. A programmer is writing a program to calculate a student's course grade using the process described. The programmer has the following procedures available.

Procedure Call	Explanation
`Min (numList)`	Returns the minimum value in the list `numList`
`Sum (numList)`	Returns the sum of the values in the list `numList`

The student's individual assignment scores are stored in the list `scores`. Which of the following can be used to calculate a student's course grade and store the result in the variable `finalGrade`?

(A)
```
finalGrade ← Sum (scores) / LENGTH (scores)
finalGrade ← finalGrade - Min (scores)
```

(B)
```
finalGrade ← Sum (scores) / (LENGTH (scores) - 1)
finalGrade ← finalGrade - Min (scores)
```

(C)
```
finalGrade ← Sum (scores) - Min (scores)
finalGrade ← finalGrade / LENGTH (scores)
```

(D)
```
finalGrade ← Sum (scores) - Min (scores)
finalGrade ← finalGrade / (LENGTH (scores) - 1)
```

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16. Consider a game where a player spins a wheel divided into four identical sections, labeled A, B, C, and D. If the player spins A, the score is `10`. If the player spins B, the score is `5`. If the player spins C or D, the score is `-1`.

The following code segment is intended to implement the game.

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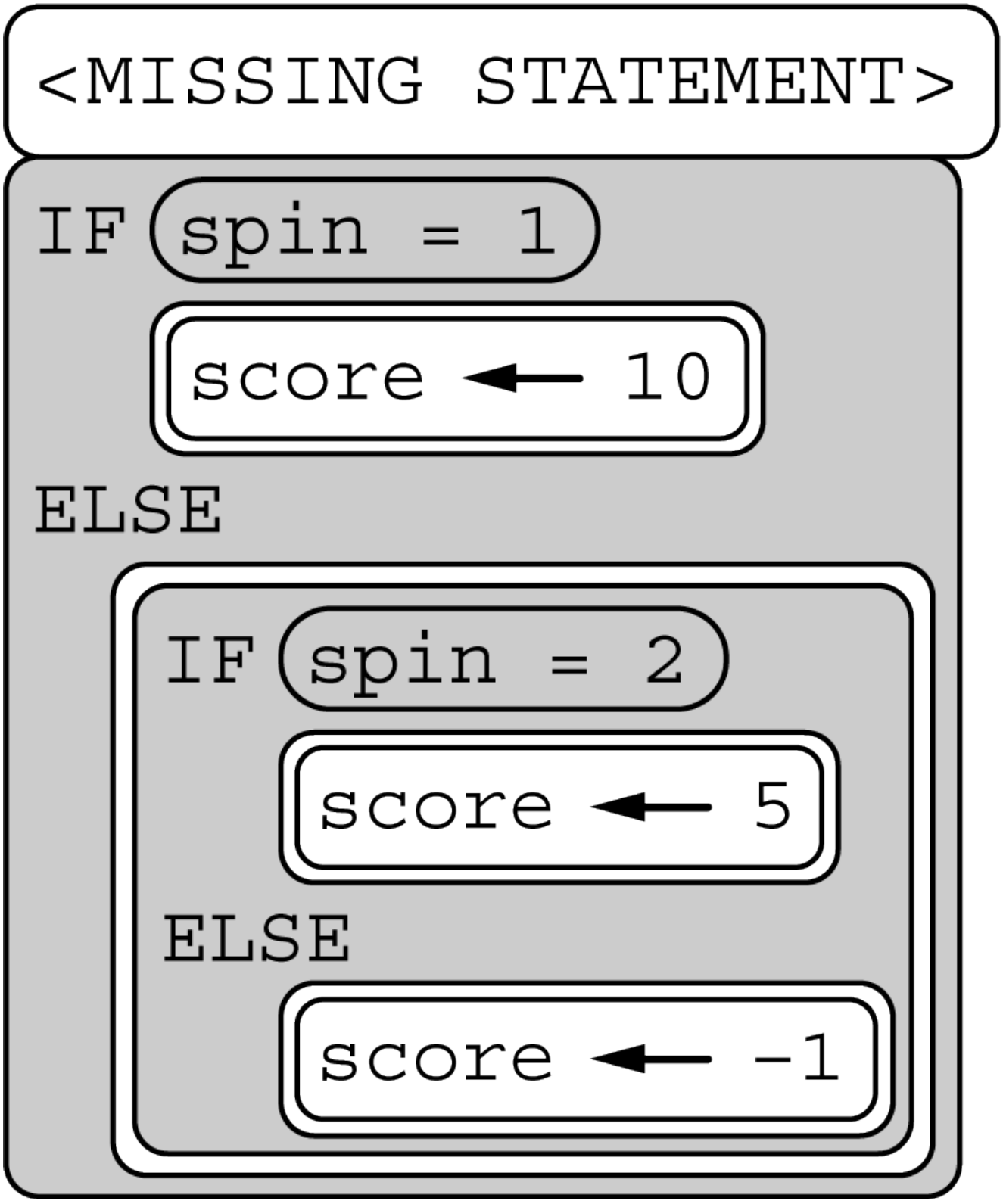

Which of the following could be used as a replacement for `<MISSING STATEMENT>` so the code segment works as intended?

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(A)
```
spin ← RANDOM 1, 3
```

(B)
```
spin ← RANDOM 1, 4
```

(C)
```
spin ← RANDOM 1, 6
```

(D)
```
spin ← RANDOM 1, 8
```

17. Consider a game in which a player flips a fair coin three times. If all three coin flips have the same result (either all heads or all tails) the player wins. Otherwise, the player loses.

Which of the following code segments best simulates the behavior of the game?

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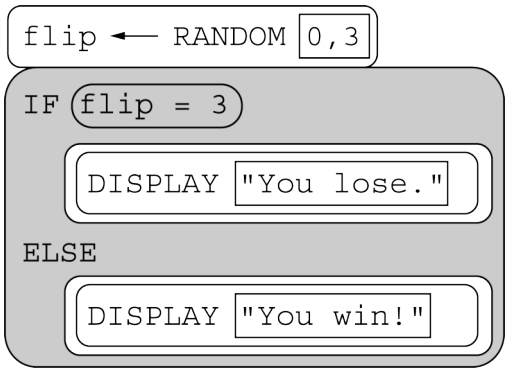
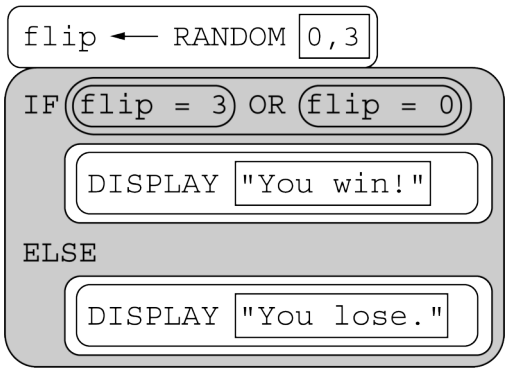
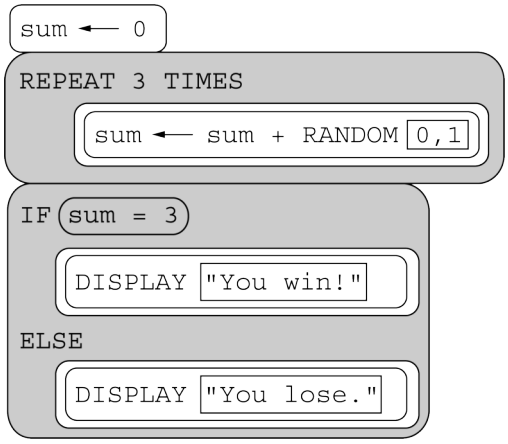
(A)



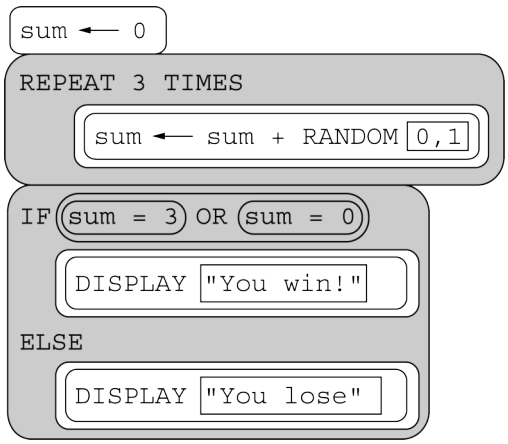
(B)



(C)



(D)



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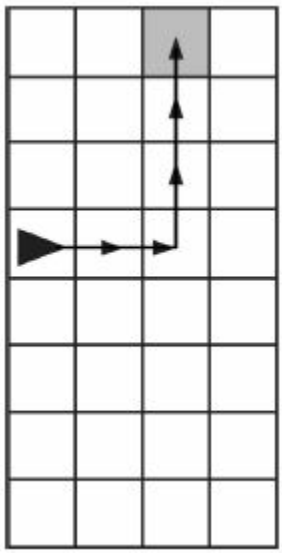
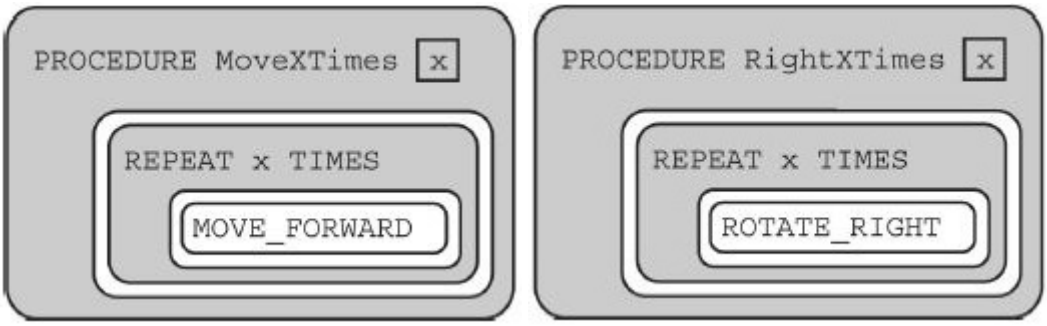
18. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

The following question uses a robot in a grid of squares. The robot is represented by a triangle, which is initially facing right.



Consider the procedures below.



Which of the following code segments will move the robot to the gray square?

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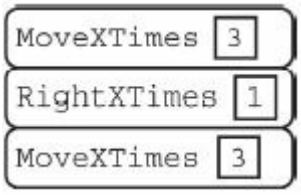
(A)

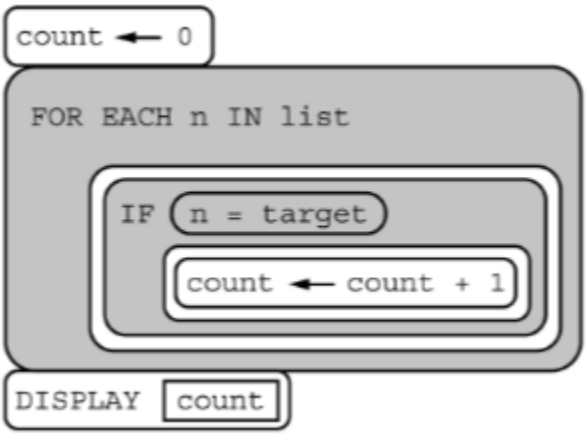
(B)

(C)



(D)

19. Consider the following program, which is intended to display the number of times a number *target* appears in a list.



Which of the following best describes the behavior of the program?

(A) The program correctly displays the number of times *target* appears in the list.

(B) The program does not work as intended when *target* does not appear in the list.

(C) The program does not work as intended when *target* appears in the list more than once.

(D) The program does not work as intended when *target* appears as the last element of the list.

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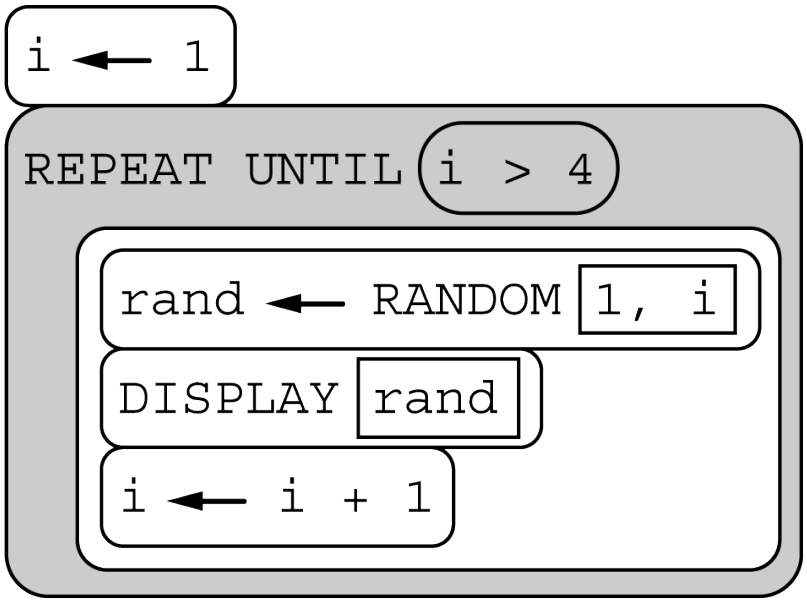
20. Consider the following code segment.



Which of the following CANNOT be displayed as a result of executing the code segment?

(A) `1 1 1 1`

(B) `1 2 3 2`

(C) `1 2 3 4`

(D) `1 3 2 4`

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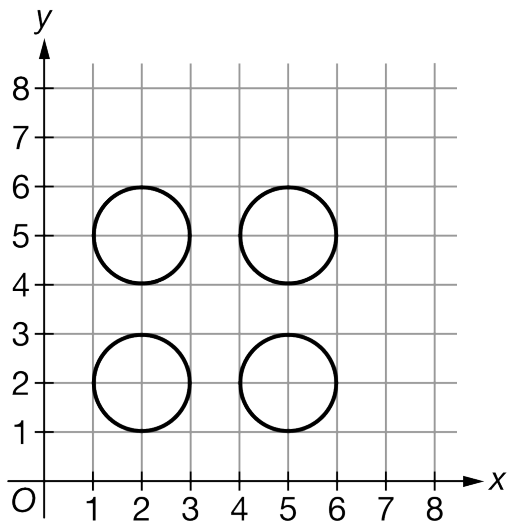
21. Consider the following procedure.

Procedure Call	Explanation
`drawCircle(xPos, yPos, rad)`	Draws a circle on a coordinate grid with center `(xPos, yPos)` and radius `rad`

The `drawCircle` procedure is to be used to draw the following figure on a coordinate grid.



Let the value of the variable `x` be `2`, the value of the variable `y` be `2`, and the value of the variable `r` be `1`. Which of the following code segments can be used to draw the figure?

(A)
```
drawCircle(x, y, r)
drawCircle(x, y + 2, r)
drawCircle(x + 2, y, r)
drawCircle(x + 2, y + 2, r)
```

(B)
```
drawCircle(x, y, r)
drawCircle(x, y + 3, r)
drawCircle(x + 3, y, r)
drawCircle(x + 3, y + 3, r)
```

(C)
```
drawCircle(x, y, r + 2)
drawCircle(x, y + 2, r + 2)
drawCircle(x + 2, y, r + 2)
drawCircle(x + 2, y + 2, r + 2)
```

(D)
```
drawCircle(x, y, r + 3)
drawCircle(x, y + 3, r + 3)
drawCircle(x + 3, y, r + 3)
drawCircle(x + 3, y + 3, r + 3)
```

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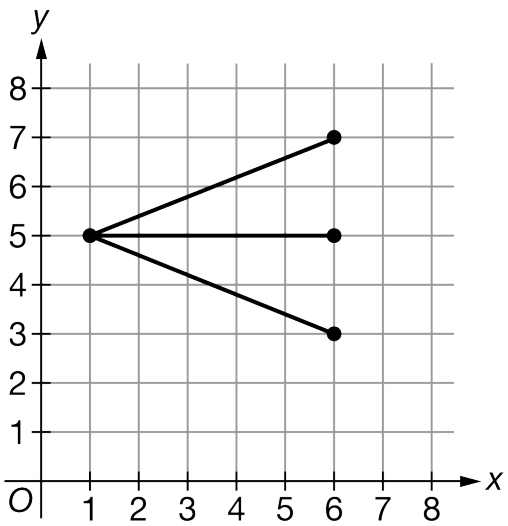
22. Consider the following procedure.

Procedure Call	Explanation
`drawLine(x1, y1, x2, y2)`	Draws a line segment on a coordinate grid with endpoints at coordinates `(x1, y1)` and `(x2, y2)`

The `drawLine` procedure is to be used to draw the following figure on a coordinate grid.



Let the value of the variable `xVal` be `6` and the value of the variable `yVal` be `5`. Which of the following code segments can be used to draw the figure?

(A)
```
drawLine(1, 5, xVal, yVal)
drawline(1, 5, xVal, yVal + 2)
drawline(1, 5, xVal, yVal + 2)
```

(B)
```
drawLine(1, 5, xVal, yVal)
drawline(1, 5, xVal, yVal + 2)
drawline(1, 5, xVal, yVal - 2)
```

(C)
```
drawLine(1, 5, xVal, yVal)
drawline(1, 5, xVal + 2, yVal + 2)
drawline(1, 5, xVal + 2, yVal - 2)
```

(D)
```
drawLine(1, 5, xVal, yVal)
drawline(1, 5, xVal + 2, yVal + 2)
drawline(1, 5, xVal - 2, yVal - 2)
```

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23. The procedure *Draw (length, direction)* is used to draw a line segment *length* units long in a given *direction* (left, right, up, or down), starting at the current cursor position. The cursor is then repositioned at the end of the line segment that was drawn. Consider the following program, where the cursor starts in the upper left corner of a grid of dots. The dots are spaced one unit apart.

Draw (1, right)

Draw (2, down)

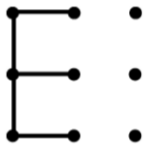
Draw (1, left)

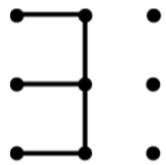
Draw (1, right)

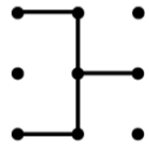
Draw (1, up)

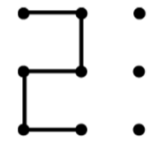
Draw (1, left)

Which of the following represents the figure that is drawn by the program?

(A) 

(B) 

(C) 

(D) 

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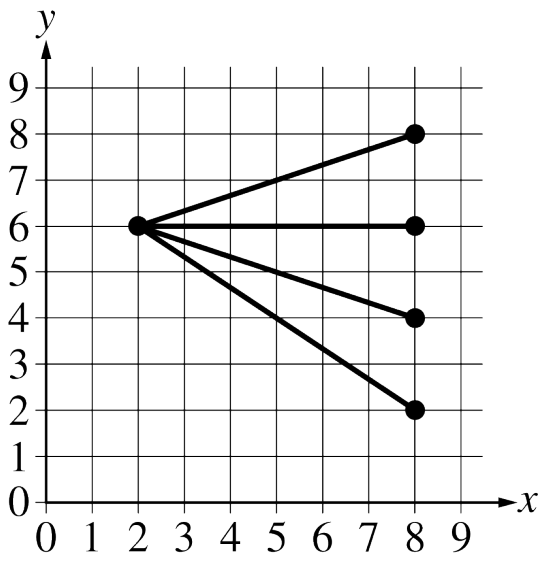
24. Consider the following procedure.

Procedure Call	Explanation
`DrawLine (x1, y1, x2, y2)`	Draws a line segment on a coordinate grid with endpoints at coordinates `(x1, y1)` and `(x2, y2)`

The `DrawLine` procedure is to be used to draw the following figure on a coordinate grid.



The following code segment is intended to draw the figure.

```
startX ← 2
startY ← 6
endX ← 8
endY ← 8
REPEAT 4 TIMES
{
     <MISSING CODE>
}
```

Which of the following can be used to replace `<MISSING CODE>` so that the figure is drawn correctly?

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(A)
```
DrawLine (startX, startY, endX, endY)
endY ← endY - 2
```

(B)
```
DrawLine (startX, startY, endX, endY)
endX ← endX - 2
endY ← endY - 2
```

(C)
```
endY ← endY - 2
DrawLine (startX, startY, endX, endY)
```

(D)
```
endX ← endX - 2
endY ← endY - 2
DrawLine (startX, startY, endX, endY)
```

25. In the following procedure, the parameter `age` represents a person's age. The procedure is intended to return the name of the age group associated with `age`. People who are under 18 are considered minors, people who are 65 and older are considered senior citizens, and all other people are considered adults. The procedure does not work as intended.

```
Line 1:  PROCEDURE ageGroup(age)
Line 2:  {
Line 3:     result ← "adult"
Line 4:     IF(age ≥ 65)
Line 5:     {
Line 6:        result ← "senior citizen"
Line 7:     }
Line 8:     RETURN(result)
Line 9:
Line 10:    result ← "adult"
Line 11:    IF(age < 18)
Line 12:    {
Line 13:       result ← "minor"
Line 14:    }
Line 15:    RETURN(result)
Line 16: }
```

Removing which two lines of code will cause the procedure to work as intended?

Select two answers.

A Line 3

B Line 8

C Line 10

D Line 15

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26. A list of numbers is considered increasing if each value after the first is greater than or equal to the preceding value. The following procedure is intended to return `true` if `numberList` is increasing and return `false` otherwise. Assume that `numberList` contains at least two elements.

```
Line 1:  PROCEDURE isIncreasing(numberList)
Line 2:  {
Line 3:     count ← 2
Line 4:     REPEAT UNTIL(count > LENGTH(numberList))
Line 5:     {
Line 6:        IF(numberList[count] < numberList[count - 1])
Line 7:        {
Line 8:           RETURN(true)
Line 9:        }
Line 10:       count ← count + 1
Line 11:    }
Line 12:    RETURN(false)
Line 13: }
```

Which of the following changes is needed for the program to work as intended?

(A) In line 3, `2` should be changed to `1`.

(B) In line 6, `<` should be changed to `≥`.

(C) Lines 8 and 12 should be interchanged.

(D) Lines 10 and 11 should be interchanged.

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27. In a science experiment, result X is expected to occur 25% of the time and result Y is expected to occur the remaining 75% of the time. The following code segment is intended to simulate the experiment if there are 100 trials.

```
Line 1:  xCount ← 0
Line 2:  yCount ← 0
Line 3:  REPEAT 100 TIMES
Line 4:  {
Line 5:     IF(RANDOM(1, 4) = 1)
Line 6:     {
Line 7:        xCount ← xCount + 1
Line 8:     }
Line 9:     IF(RANDOM(1, 4) > 1)
Line 10:    {
Line 11:       yCount ← yCount + 1
Line 12:    }
Line 13: }
Line 14: DISPLAY("Result X occurred")
Line 15: DISPLAY(xCount)
Line 16: DISPLAY("times and result Y occurred")
Line 17: DISPLAY(yCount)
Line 18: DISPLAY("times.")
```

A programmer runs the code segment, and the following message is displayed.

```
Result X occurred 24 times and result Y occurred 70 times.
```

The result shows that 94 trials were counted, rather than the intended 100 trials. Which of the following changes to the code segment will ensure a correct simulation of the experiment?

(A) Replacing line 9 with `IF(RANDOM(1, 4) ≥ 2)`

(B) Replacing line 9 with `ELSE`

(C) Interchanging lines 5 and 9

(D) Interchanging lines 7 and 11

28. For which of the following lists can a binary search be used to search for an item in the list?

I. `["blue", "green", "jade", "mauve", "pink"]`
II. `[5, 5, 5, 5, 6, 7, 8, 8, 8]`
III. `[10, 5, 3, 2, -4, -8, -9, -12]`

(A) I only

(B) III only

(C) I and III only

(D) I, II, and III

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29. A programmer notices the following two procedures in a library. The procedures do similar, but not identical, things.

- Procedure `MaxTwo (x, y)` returns the greater of its two integer parameters.
- Procedure `MaxThree (x, y, z)` returns the greatest of its three integer parameters.

Which of the following procedures is a generalization of the `MaxTwo` and `MaxThree` procedures?

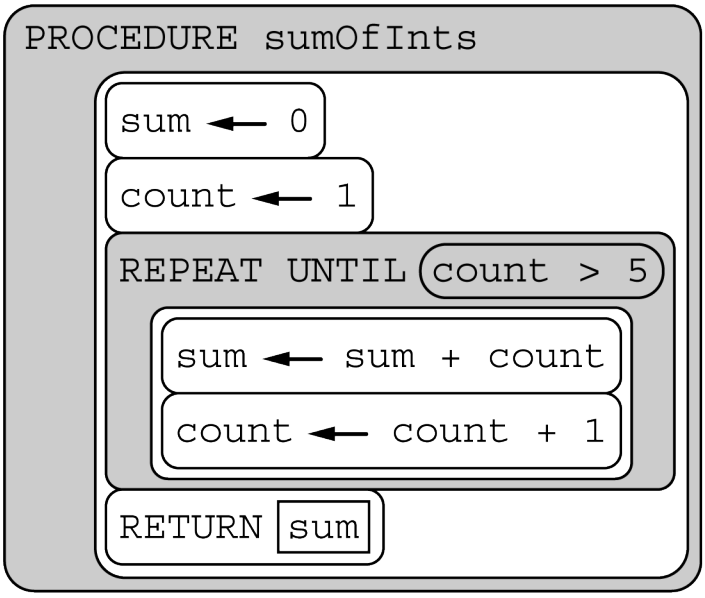
(A) Procedure `Min (x, y)`, which returns the lesser of its two integer parameters

(B) Procedure `Max (numList)`, which returns the maximum value in the list of integers `numList`

(C) Procedure `MaxFour (w, x, y, z)`, which returns the greatest of its four integer parameters

(D) Procedure `OverMax (numList, max)`, which returns the number of integers in `numList` that exceed the integer value `max`

30. A student wrote the following procedure to calculate the sum of the integers from `1` to `5`.



The student later decides to modify the procedure to calculate the sum of the integers from `1` to `max`, which represents any positive integer greater than `1`.

Which of the following changes should be made to the procedure to meet the student's goal?

I. The procedure should take `max` as an input parameter.
II. The condition in the `REPEAT UNTIL` block should be changed to `count > max`.
III. The condition in the `REPEAT UNTIL` block should be changed to `max < 5`.

(A) I only

(B) II only

(C) I and II

(D) I and III

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31. A game program contains the following code to update three score variables, `health`, `food`, and `knowledge`. The maximum values for the three variables are `100`, `80`, and `25`, respectively.

```
health ← health + 10
IF(health > 100)
{
     health ← 100
}
food ← food + 1
IF(food > 80)
{
     food ← 80
}
knowledge ← knowledge + 5
IF(knowledge > 25)
{
     knowledge ← 25
}
```

The game program's author would like to write a procedure that could be used to update any variable in the game (`myScore`) that has a maximum value (`myLimit`) by a given amount (`myAmount`). A correct call of the procedure is shown below.

```
myScore ← updateScore(myScore, myAmount, myLimit)
```

Which of the following is a correct implementation of `updateScore`?

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(A)

```
PROCEDURE updateScore(score, amount, limit)
{
     score ← score + amount
     IF (score > limit)
     {
         score ← limit
     }
}
```

(B)

```
PROCEDURE updateScore(score, amount, limit)
{
     score ← score + amount
     IF(score > amount)
     {
         score ← limit
     }
     RETURN(limit)
}
```

(C)

```
PROCEDURE updateScore(score, amount, limit)
{
     score ← score + amount
     IF(score > limit)
     {
         score ← limit
     }
     RETURN(score)
}
```

(D)

```
PROCEDURE updateScore(score, amount, limit)
{
     IF(score = health)
     {
         score ← score + 10
     }
     IF(score = food)
     {
         score ← score + 1
     }
     IF(score = knowledge)
     {
         score ← score + 5
     }
     IF(score > limit)
     {
         score ← limit
     }
}
```

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32. A computer program contains code in several places that asks a user to enter an integer within a specified range of values. The code repeats the input request if the value that the user enters is not within the specified range. A programmer would like to create a procedure that will generalize this functionality and can be used throughout the program. The correct use of the procedure is shown below, where `min` is the least acceptable value, `max` is the greatest acceptable value, and `promptString` is the string that should be printed to prompt the user enter a value.

```
inputVal ← getRange(min, max, promptString)
```

Which of the following is a correct implementation of the `getRange` procedure?

(A)
```
PROCEDURE getRange(min, max, promptString)
{
     DISPLAY(promptString)
     RETURN(INPUT())
}
```

(B)
```
PROCEDURE getRange(min, max, promptString)
{
     DISPLAY(promptString)
     x ← INPUT()
     RETURN(x)
}
```

(C)
```
PROCEDURE getRange(min, max, promptString)
{
     DISPLAY(promptString)
     x ← INPUT()
     REPEAT UNTIL(x ≥ min AND x ≤ max)
     {
         DISPLAY(promptString)
         x ← INPUT()
     }
}
```

(D)
```
PROCEDURE getRange(min, max, promptString)
{
     DISPLAY(promptString)
     x ← INPUT()
     REPEAT UNTIL(x ≥ min AND x ≤ max)
     {
         DISPLAY(promptString)
         x ← INPUT()
     }
     RETURN(x)
}
```

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33. Directions: For the question or incomplete statement below, two of the suggested answers are correct. For this question, you must select both correct choices to earn credit. No partial credit will be earned if only one correct choice is selected. Select the two that are best in each case.

In a certain district, 20 percent of the voters are expected to vote for Candidate A in an election. The computer program below is intended to simulate the result of the election with `n` voters, and display the number of votes received by Candidate A.

```
Line 1:  sum ← 0
Line 2:  REPEAT n TIMES
Line 3:  {
Line 4:     IF (<MISSING CONDITION>)
Line 5:     {
Line 6:        sum ← sum + 1
Line 7:     }
Line 8:  }
Line 9:  DISPLAY (sum)
```

Which of the following can be used to replace `<MISSING CONDITION>` in line 4 so that the program works as intended?

Select <u>two</u> answers.

A `RANDOM (1, 5) = 1`

B `RANDOM (1, 5) ≤ 2`

C `RANDOM (1, 10) = 2`

D `RANDOM (1, 10) ≤ 2`

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34. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

In a certain science experiment, 75 percent of trials are expected to be successful and 25 percent of trials are expected to be unsuccessful. The program below is intended to simulate the results of repeated trials of the experiment.

```
successful ← 0
unsuccessful ← 0
REPEAT 1000 TIMES
{
   IF (<MISSING CODE>)
   {
      successful ← successful + 1
   }
   ELSE
   {
      unsuccessful ← unsuccessful + 1
   }
}
DISPLAY (successful)
DISPLAY ("trials were successful,")
DISPLAY (unsuccessful)
DISPLAY ("trials were unsuccessful.")
```

Which of the following can be used to replace <MISSING CODE> so that the simulation works as intended?

(A) `RANDOM (1, 100) = 25`

(B) `RANDOM (1, 100) ≤ 25`

(C) `RANDOM (1, 100) = 75`

(D) `RANDOM (1, 100) ≤ 75`

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35. In the procedure *Mystery* below, the parameter *number* is a positive integer.

```
PROCEDURE Mystery (number)
{
   REPEAT UNTIL (number ≤ 0)
   {
      number ← number - 2
   }
   IF (number = 0)
   {
      RETURN (true)
   }
   ELSE
   {
      RETURN (false)
   }
}
```

Which of the following best describes the result of running the procedure *Mystery*?

(A) The procedure returns *true* when the initial value of *number* is 2, and it otherwise returns *false*.

(B) The procedure returns *true* when the initial value of *number* is greater than 2, and it otherwise returns *false*.

(C) The procedure returns *true* when the initial value of *number* is even, and it otherwise returns *false*.

(D) The procedure returns *true* when the initial value of *number* is odd, and it otherwise returns *false*.

36. **Directions: For the question or incomplete statement below, two of the suggested answers are correct. For this question, you must select both correct choices to earn credit. No partial credit will be earned if only one correct choice is selected. Select the two that are best in each case.**

Which of the following are ways in which a programmer can use abstraction to manage the complexity of a program?

Select two answers.

A Replacing each instance of repeated code with a call to a procedure

B Replacing longer variable names with shorter variable names to reduce typing errors

C Replacing several lines of documentation with a single line of documentation

D Replacing several lines of documentation with a single line of documentation `name1`, `name2`, `name3`, and `name4` with a list of strings called `names`

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37. A computer science student completes a program and asks a classmate for feedback. The classmate suggests rewriting some of the code to include more procedural abstraction. Which of the following is NOT a benefit of procedural abstraction?

(A) Making the code more readable

(B) Making the code run faster

(C) Providing more opportunities for code reuse

(D) Reducing the amount of duplicated code

38. Consider two lists of numbers called `list1` and `list2`. A programmer wants to determine how many different values appear in both lists. For example, if `list1` contains `[10, 10, 20, 30, 40, 50, 60]` and `list2` contains `[20, 20, 40, 60, 80]`, then there are three different values that appear in both lists (`20`, `40`, and `60`).

The programmer has the following procedures available.

Procedure Call	Explanation
`Combine (myList1, myList2)`	This procedure creates a new list containing the elements from `myList1` followed by the entries from `myList2`. The resulting list is returned. For example, if `myList1` contains `[2, 4, 6]` and `myList2` contains `[1, 5]`, the procedure will return the list `[2, 4, 6, 1, 5]`.
`RemoveAllDups (myList)`	This procedure creates a new list containing the elements of `myList` with any duplicate values removed. The resulting list is returned. For example, if `myList` contains `[3, 2, 4, 2, 2, 5, 6, 4]`, the procedure will return the list `[3, 2, 4, 5, 6]`.

Which of the following can be used to assign the intended value to `count`?

(A)
```
bothList ← Combine (list1, list2)
uniqueList ← RemoveAllDups (bothList)
count ← LENGTH (bothList) - LENGTH (uniqueList)
```

(B)
```
newList1 ← RemoveAllDups (list1)
newList2 ← RemoveAllDups (list2)
bothList ← Combine (newList1, newList2)
count ← LENGTH (list1) + LENGTH (list2) - LENGTH (bothList)
```

(C)
```
newList1 ← RemoveAllDups (list1)
newList2 ← RemoveAllDups (list2)
bothList ← Combine (newList1, newList2)
count ← LENGTH (newList1) + LENGTH (newList2) - LENGTH (bothList)
```

(D)
```
newList1 ← RemoveAllDups (list1)
newList2 ← RemoveAllDups (list2)
bothList ← Combine (newList1, newList2)
uniqueList ← RemoveAllDups (bothList)
count ← LENGTH (bothList) - LENGTH (uniqueList)
```

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39. In the following procedure, the parameter `str` is a string and the parameter `num` is a number.

```
PROCEDURE printArgs(str, num)
{
     DISPLAY(num)
     DISPLAY(str)
     DISPLAY(num)
}
```

Consider the following code segment.

```
printArgs("**", 1)
printArgs("*", 2)
```

What is displayed as a result of executing the code segment?

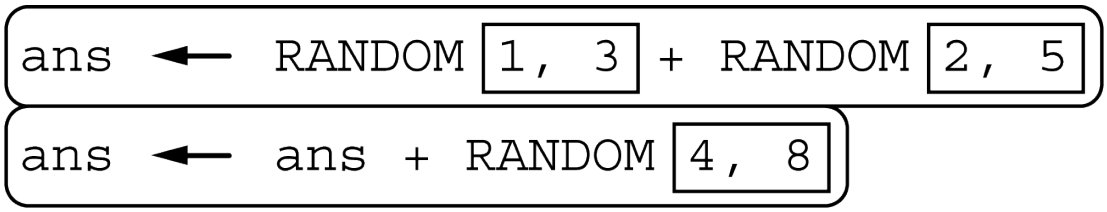
(A) `1 * 1 2 ** 2`

(B) `1 ** 1 2 * 2`

(C) `* 1 * ** 2 **`

(D) `** 1 ** * 2 *`

40. Consider the following code segment.



Which of the following describes the possible values of `ans` as a result of executing the code segment?

(A) Any integer value from `1` to `8`, inclusive

(B) Any integer value from `1` to `16`, inclusive

(C) Any integer value from `4` to `8`, inclusive

(D) Any integer value from `7` to `16`, inclusive

41. A student has a data file containing 10,000 numerical values. The student is writing a program to compute the average of the numbers contained in the file. Which of the following procedures is most likely to be useful in the student's program?

(A) A procedure that returns the quotient when dividing one value by another

(B) A procedure that returns the sum when adding one value to another

(C) A procedure that returns the sum of the values in the file

(D) A procedure that returns `true` if the file contains any duplicate values and returns `false` otherwise

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42. A student is writing a program that is intended to replace each negative value in a particular column of a spreadsheet with the value 0. Which of the following procedures is most likely to be useful in the student's program?

(A) A procedure `containsNegatives`, which returns `true` if any negative values appear in the column and returns `false` otherwise.

(B) A procedure `countNegatives`, which returns the number of negative values that appear in the column.

(C) A procedure `findNegative`, which returns the row number of the first negative value that appears in the column or `-1` if there are no negative values.

(D) A procedure `minimum`, which returns the minimum value that appears in the column.

43. Which of the following procedures would be most useful as part of a program to determine whether a word appears in two different text files?

(A) A procedure `getWords`, which takes a positive integer `n` and a text file as input and returns the first `n` words in the text file.

(B) A procedure `isFound`, which takes a word and a text file as input and returns `true` if the word appears in the text file

(C) A procedure `textMatch`, which takes two text files as input and returns `true` if the two text files are identical.

(D) A procedure `sameSize`, which takes two text files as input and returns `true` if the two text files contain the same number of words.

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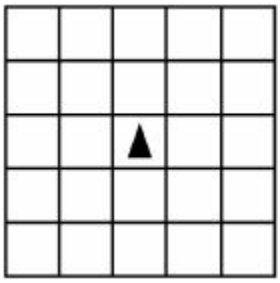
44. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

The question below uses a robot in a grid of squares. The robot is represented as a triangle, which is initially in the center square of the grid and facing toward the top of the grid.



The following code segment is used to move the robot within the grid.

```
x ← RANDOM (1, 3)
REPEAT x TIMES
{
   ROTATE_RIGHT ()
}
y ← RANDOM (1, 2)
REPEAT y TIMES
{
   MOVE_FORWARD ()
}
```

A gray square represents a possible final location of the robot after the code segment is executed. Which of the following represents all possible final locations for the robot?

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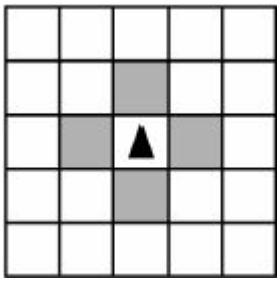
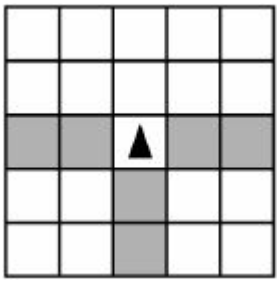
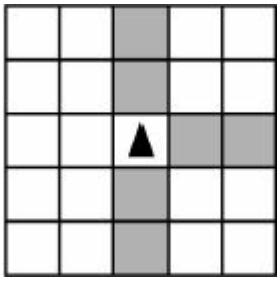
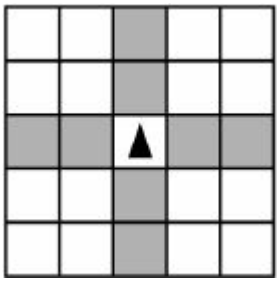
(A) 

(B) 

(C) 

(D) 

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45. The following procedures are available for string manipulation.

Procedure Call	Explanation
`substring(str, start, end)`	Returns a substring of consecutive characters of `str` starting with the character at position `start` and ending with the character at position `end`. The first character of `str` is considered position 1. For example, `substring("delivery", 3, 6)` returns `"live"`.
`concat(str1, str2)`	Returns a single string consisting of `str1` followed by `str2`. For example, `concat("key", "board")` returns `"keyboard"`.
`len(str)`	Returns the number of characters in `str`. For example, `len("key")` returns `3`.

A programmer wants to create a new string by removing the character in position `n` of the string `oldStr`. For example, if `oldStr` is `"best"` and `n` is `3`, then the new string should be `"bet"`. Assume that `1 < n < len(oldStr)`.

Which of the following code segments can be used to create the desired new string and store it in `newStr`?

Select two answers.

A
```
left ← substring(oldStr, 1, n - 1)
right ← substring(oldStr, n + 1, len(oldStr))
newStr ← concat(left, right)
```

B
```
left ← substring(oldStr, 1, n + 1)
right ← substring(oldStr, n - 1, len(oldStr))
newStr ← concat(left, right)
```

C
```
newStr ← substring(oldStr, 1, n - 1)
newStr ← concat(newStr, substring(oldStr, n + 1, len(oldStr)))
```

D
```
newStr ← substring(oldStr, n + 1, len(oldStr))
newStr ← concat(newStr, substring(oldStr, 1, n - 1))
```

46. The procedure `BinarySearch (numList, target)` correctly implements a binary search algorithm on the list of numbers `numList`. The procedure returns an index where `target` occurs in `numList`, or `-1` if `target` does not occur in `numList`. Which of the following conditions must be met in order for the procedure to work as intended?

(A) The length of `numList` must be even.

(B) The list `numList` must not contain any duplicate values.

(C) The values in `numList` must be in sorted order.

(D) The value of `target` must not be equal to `-1`.

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47. Consider the following procedures.

```
PROCEDURE proc1(str)
{
     DISPLAY(str)
     DISPLAY("happy")
}
PROCEDURE proc2(str1, str2)
{
     proc1(str2)
     DISPLAY(str1)
}
```

What is displayed as a result of the procedure call `proc2("birthday", "to you")`?

(A) `birthday happy to you`

(B) `birthday happy birthday`

(C) `to you birthday happy`

(D) `to you happy birthday`

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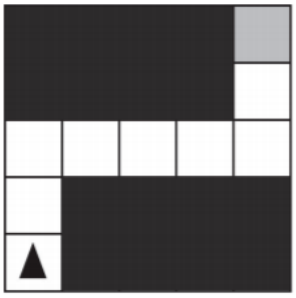
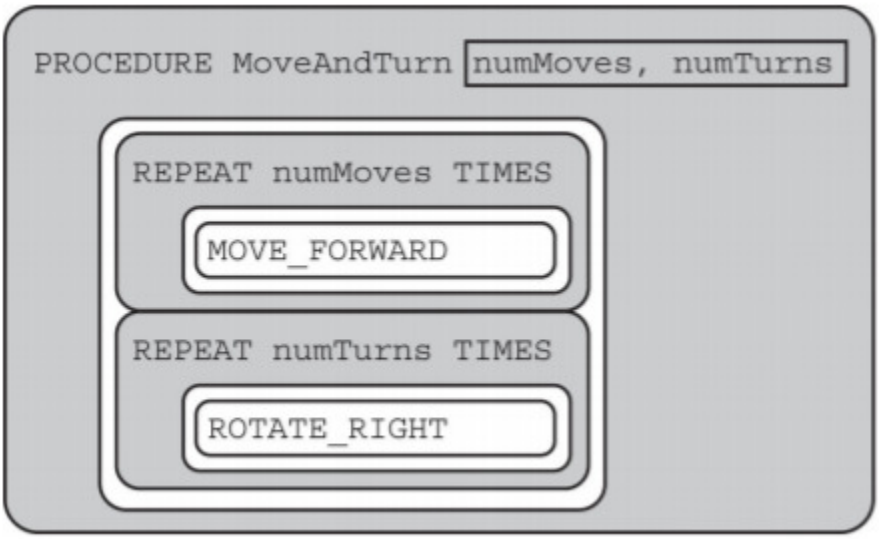
48. The figure below shows a robot in a grid of squares. The robot is represented as a triangle, which is initially facing upward. The robot can move into a white or gray square but cannot move into a black region.



Consider the procedure *MoveAndTurn* below.



Which of the following code segments will move the robot to the gray square?

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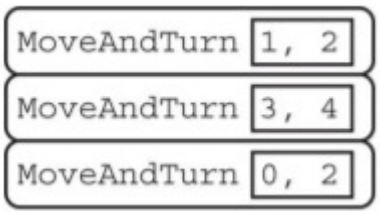
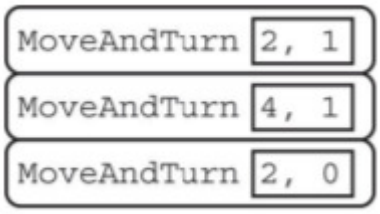
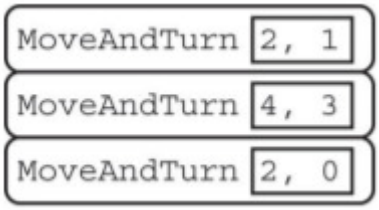
(A)



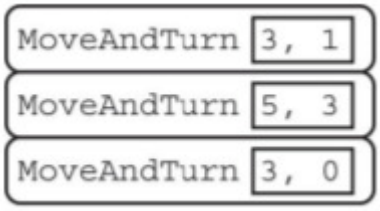
(B)



(C)



(D)



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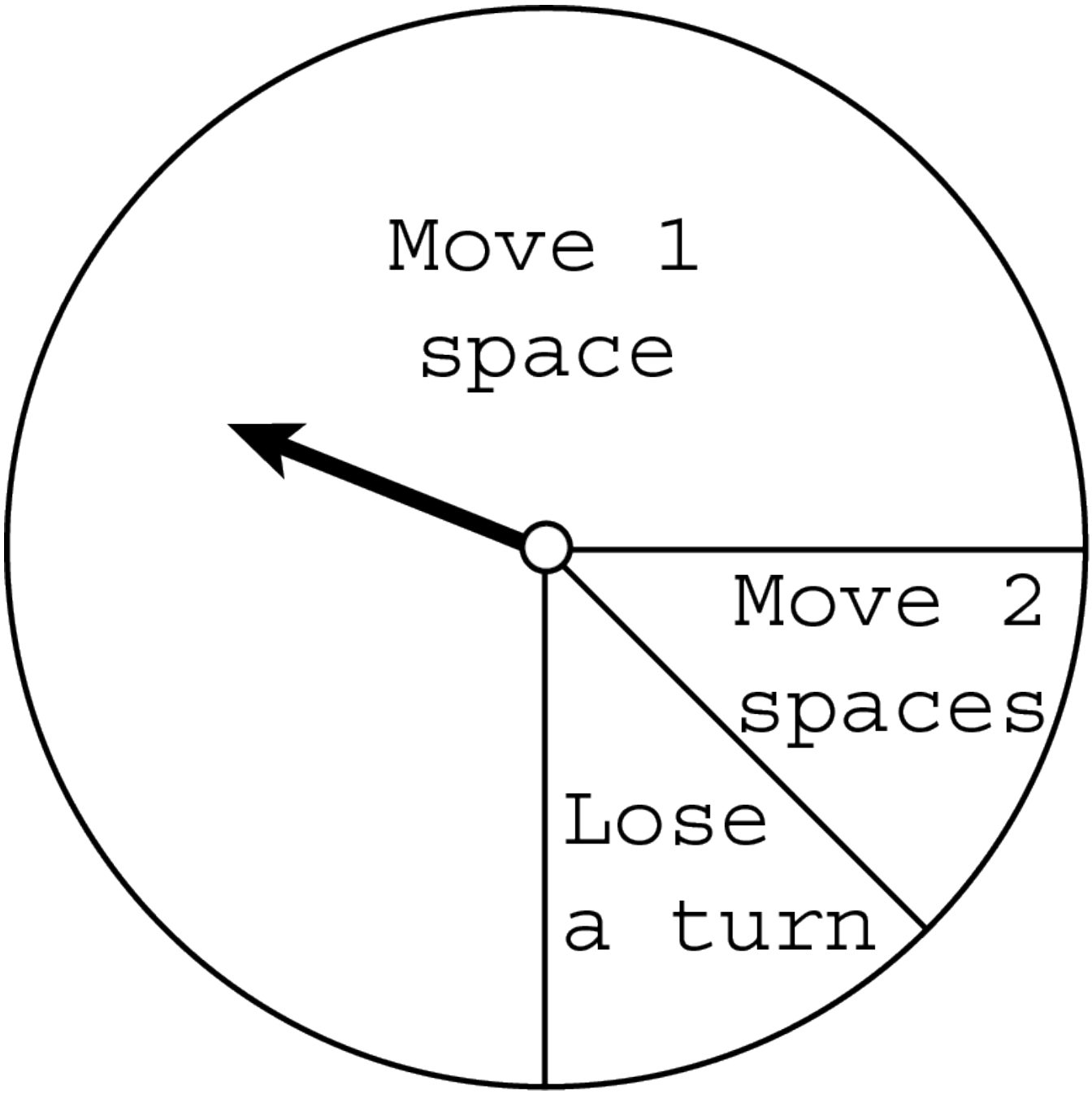
49. Consider the following spinner, which is used to determine how pieces are to be moved on a game board. The region labeled `"Move 1 space"` is six times as large as each of the other two regions.



Which of the following code segments can be used to simulate the behavior of the spinner?

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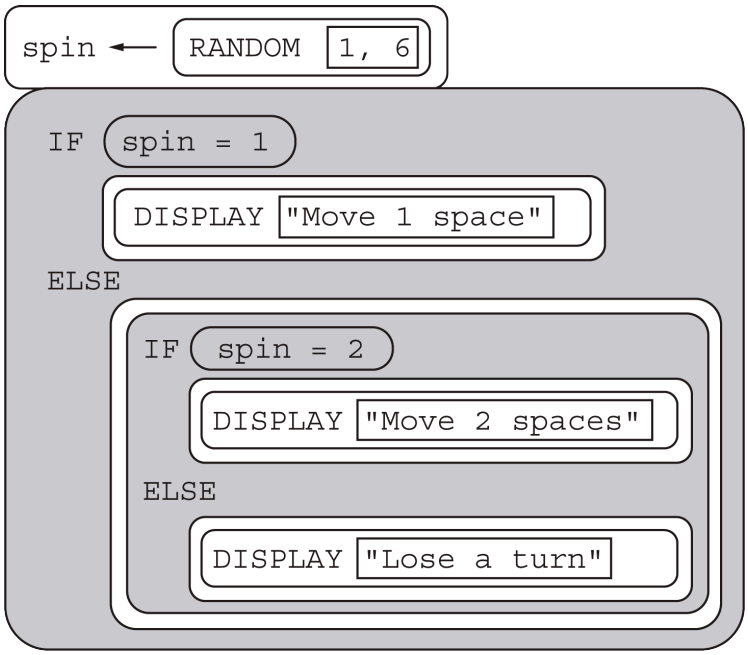
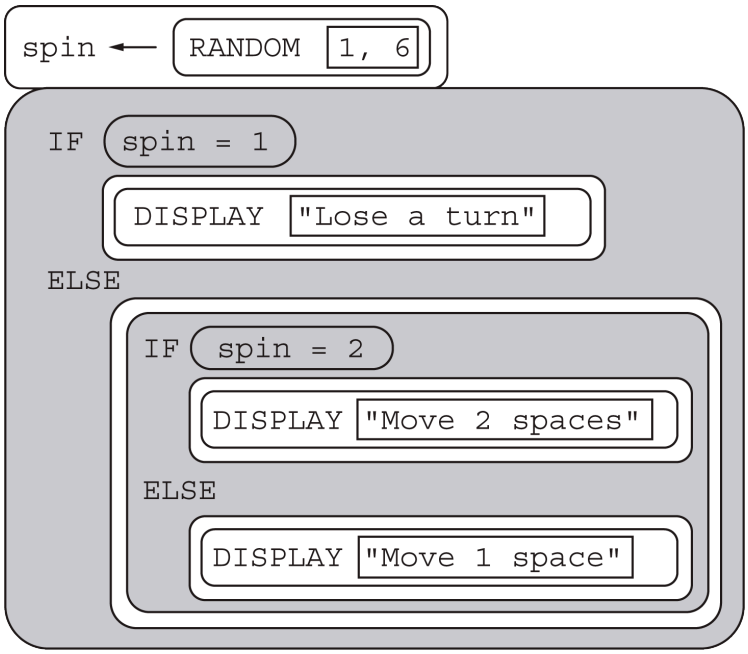
(A)



(B)



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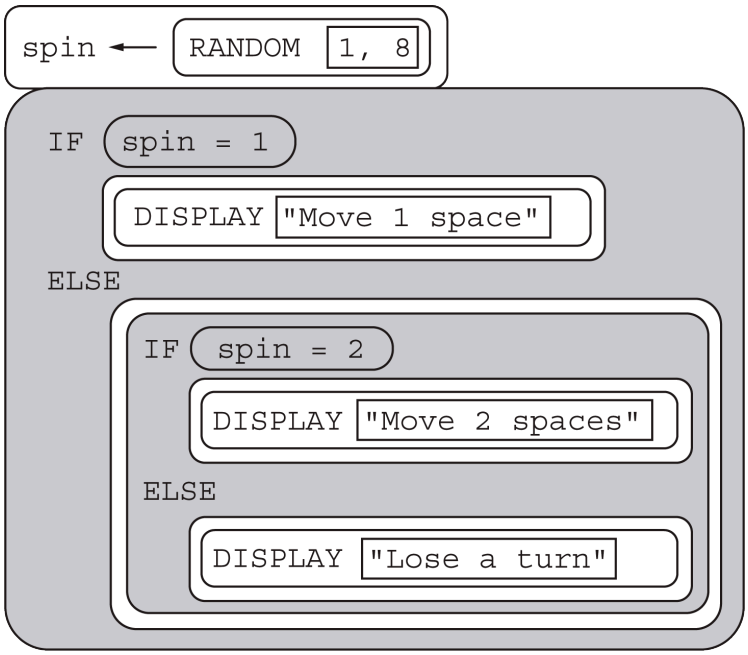
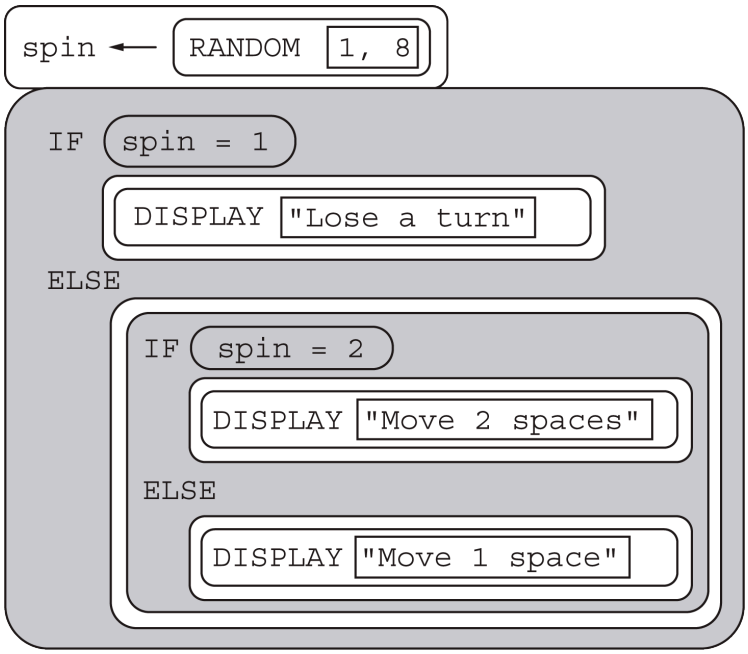
(C)



(D)



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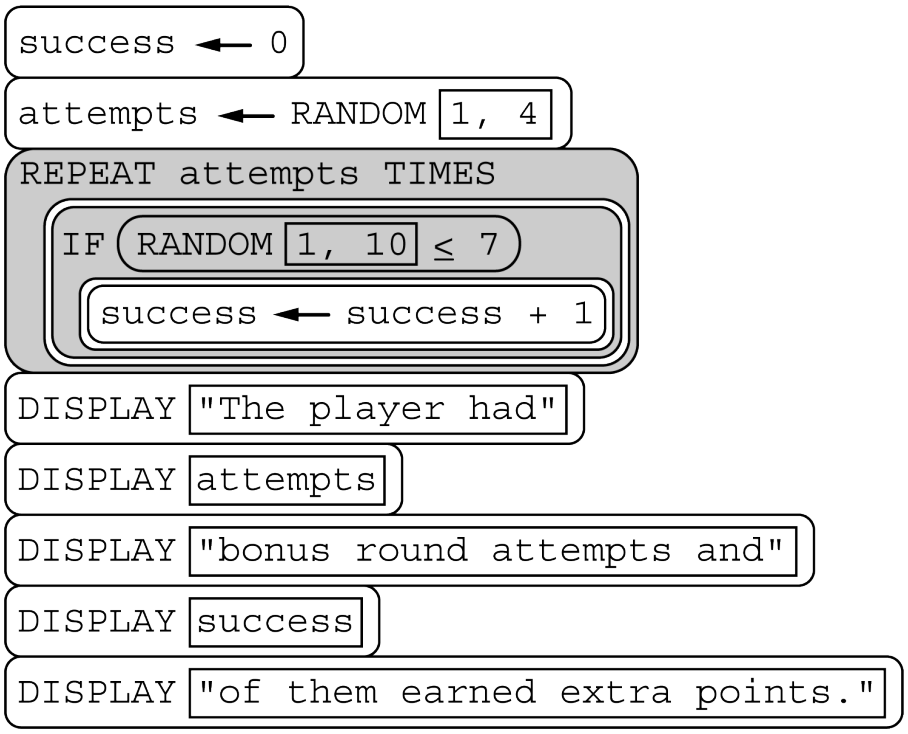
50. In a certain game, a player may have the opportunity to attempt a bonus round to earn extra points. In a typical game, a player is given 1 to 4 bonus round attempts. For each attempt, the player typically earns the extra points 70% of the time and does not earn the extra points 30% of the time.

The following code segment can be used to simulate the bonus round.



Which of the following is NOT a possible output of this simulation?

(A) `The player had 1 bonus round attempts and 1 of them earned extra points.`

(B) `The player had 2 bonus round attempts and 0 of them earned extra points.`

(C) `The player had 3 bonus round attempts and 7 of them earned extra points.`

(D) `The player had 4 bonus round attempts and 3 of them earned extra points.`

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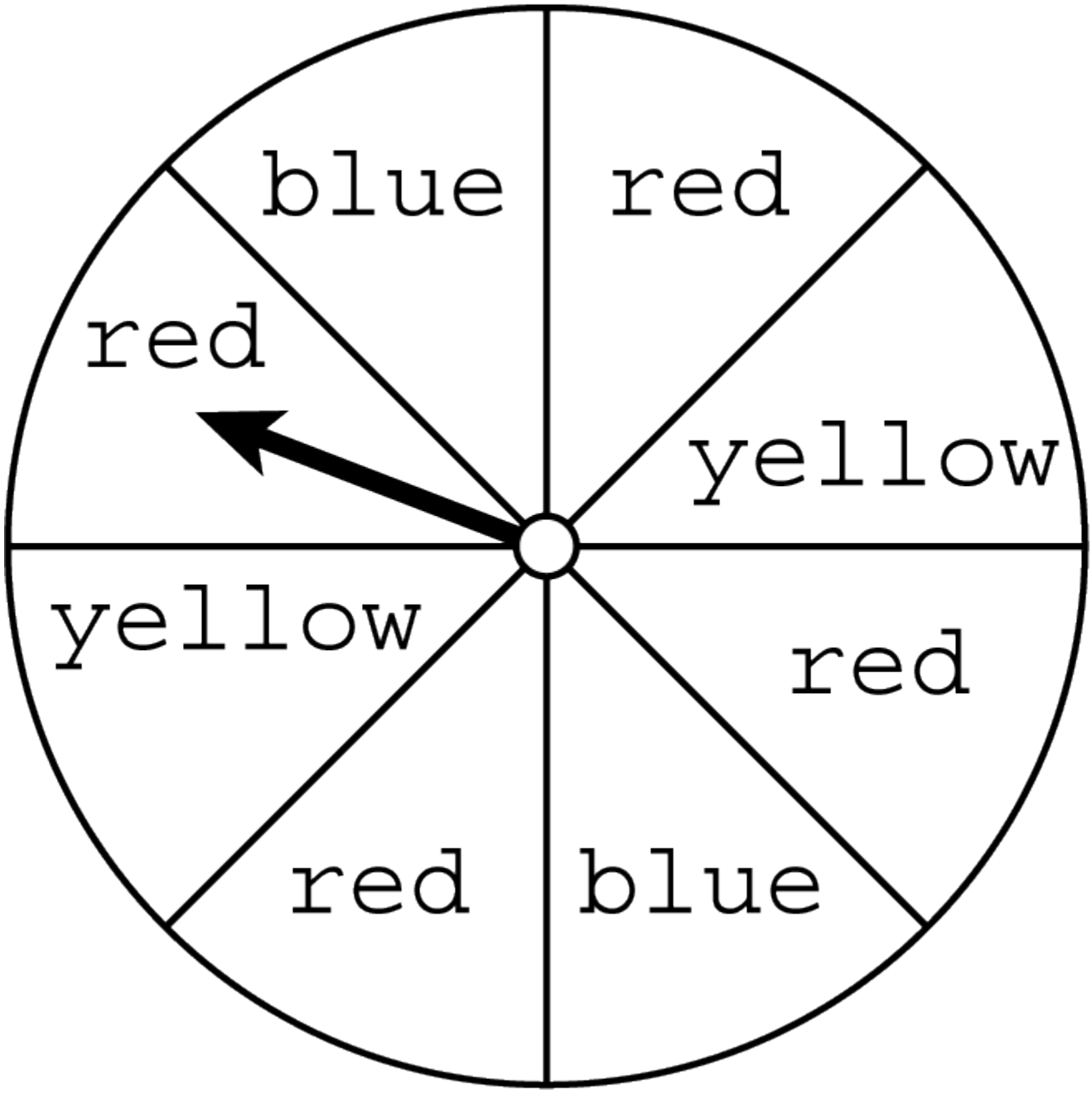
51. Consider the following spinner, which is used to determine how pieces are to be moved on a game board. Each region is of equal size.



Which of the following code segments can be used to simulate the behavior of the spinner?

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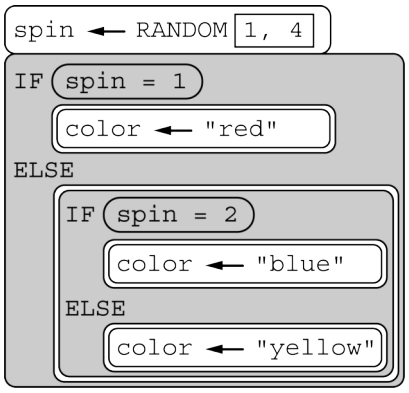
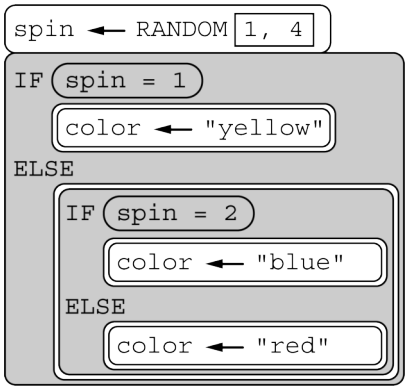
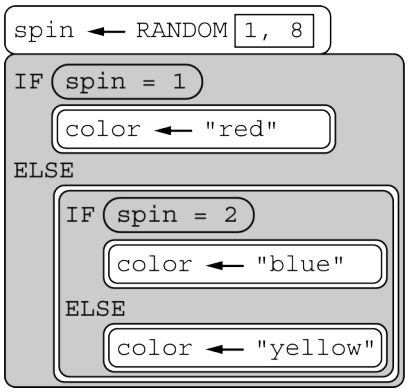
(A)



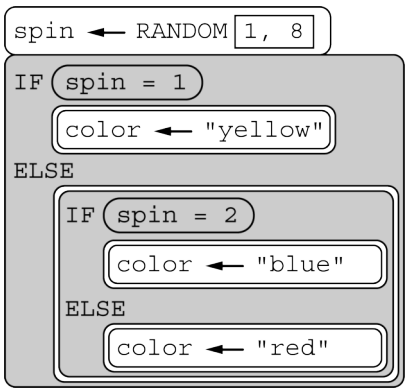
(B)



(C)



(D)



52. A spinner contains 12 regions of equal size. The regions are numbered 1 to 12. Which of the following code segments can be used to simulate the results of spinning the spinner three times and assigns the sum of the values obtained by the three spins to the variable `sum`?

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(A) `sum ← RANDOM(1, 12) + RANDOM(1, 12) + RANDOM(1, 12)`

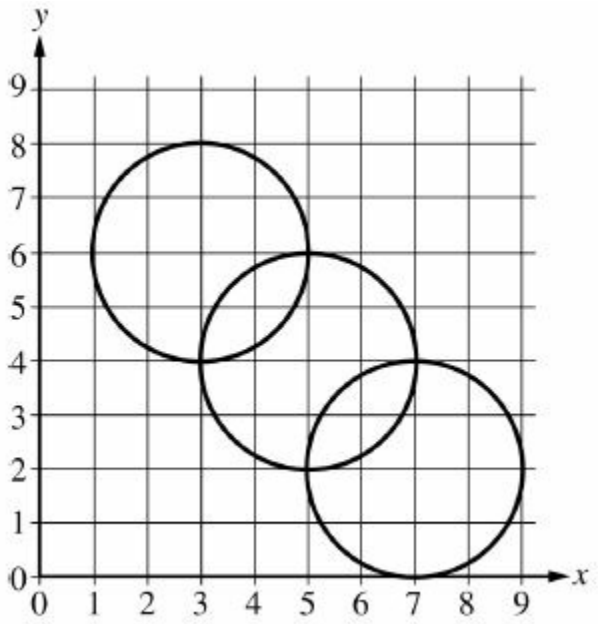
(B) `sum ← RANDOM(1, 36)`

(C) `sum ← 3 * RANDOM(1, 12)`

(D) `sum ← 12 * RANDOM(1, 3)`

53. Directions: The question or incomplete statement below is followed by four suggested answers or completions. Select the one that is best in each case.

The procedure `DrawCircle (x, y, r)` can be used to draw a circle on a coordinate grid. The circle is centered at the coordinate `(x, y)` and has a radius of `r` units. The procedure will be used to draw the following figure on a coordinate grid.



Which of the following code segments can be used to draw the figure?

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(A)
```
xPos ← 3
yPos ← 6
REPEAT 3 TIMES
{
   DrawCircle (xPos, yPos, 2)
   xPos ← xPos + 2
   yPos ← yPos + 2
}
```

(B)
```
xPos ← 3
yPos ← 6
REPEAT 3 TIMES
{
   DrawCircle (xPos, yPos, 2)
   xPos ← xPos + 2
   yPos ← yPos - 2
}
```

(C)
```
xPos ← 7
yPos ← 2
REPEAT 3 TIMES
{
   DrawCircle (xPos, yPos, 2)
   xPos ← xPos + 2
   yPos ← yPos + 2
}
```

(D)
```
xPos ← 7
yPos ← 2
REPEAT 3 TIMES
{
   DrawCircle (xPos, yPos, 2)
   xPos ← xPos + 2
   yPos ← yPos - 2
}
```

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54. A photographer has a collection of digital pictures, each using the same file-naming format: a date tag, followed by a description, followed by the file extension `".jpg"`. The photographer wants to write a code segment to extract the description from each file name, as shown in the following table.

Original File Name	Extracted Description
`2016-05-22-Andrews-Graduation.jpg`	`Andrews-Graduation`
`2016-07-04-Fireworks.jpg`	`Fireworks`
`2017-10-18-Grandmas-Birthday.jpg`	`Grandmas-Birthday`

The photographer has the following procedures available.

Procedure Call	Explanation
`TrimLeft (str, n)`	Returns a copy of the string `str` with the `n` leftmost characters removed. For example, `TrimLeft ("keyboard", 3)` returns `"board"`.
`TrimRight (str, n)`	Returns a copy of the string `str` with the `n` rightmost characters removed. For example, `TrimRight ("keyboard", 3)` returns `"keybo"`.

Let an original file name be stored in the string variable `original`. Which of the following statements will correctly extract the description and store it in the string variable `descr`?

I. `descr ← TrimLeft (TrimRight (original, 4), 11)`
II. `descr ← TrimLeft (TrimRight (original, 11), 4)`
III. `descr ← TrimRight (TrimLeft (original, 11), 4)`

(A) I only

(B) II only

(C) I and III

(D) II and III

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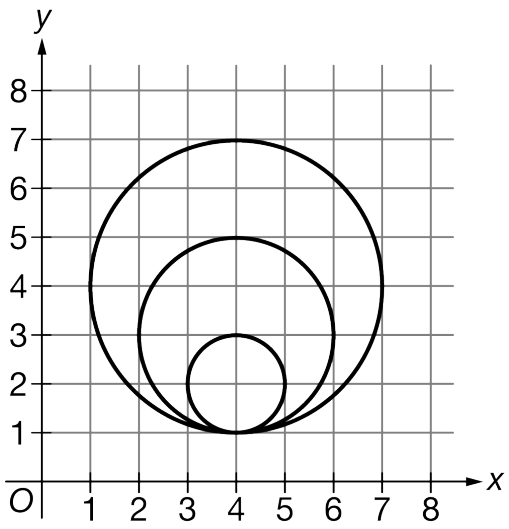
55. Consider the following procedure.

Procedure Call	Explanation
`drawCircle(xPos, yPos, rad)`	Draws a circle on a coordinate grid with center `(xPos, yPos)` and radius `rad`

The `drawCircle` procedure is to be used to draw the following figure on a coordinate grid.



Which of the following code segments can be used to draw the figure?

Select two answers.

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A

```
x ← 4
y ← 1
r ← 0
REPEAT 3 TIMES
{
     drawCircle(x, y, r)
     r ← r + 1
     y ← y + 1
}
```

B

```
x ← 4
y ← 1
r ← 0
REPEAT 3 TIMES
{
     r ← r + 1
     y ← y + 1
     drawCircle(x, y, r)
}
```

C

```
x ← 4
y ← 4
r ← 3
REPEAT 3 TIMES
{
     drawCircle(x, y, r)
     y ← y - 1
     r ← r - 1
}
```

D

```
x ← 4
y ← 4
r ← 3
REPEAT 3 TIMES
{
     y ← y - 1
     r ← r - 1
     drawCircle(x, y, r)
}
```

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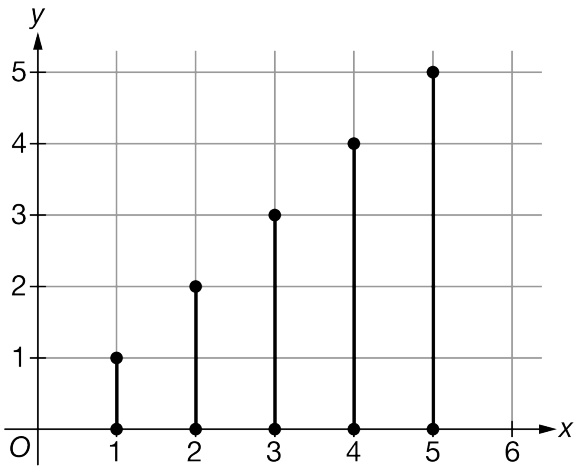
56. Consider the following procedure.

Procedure Call	Explanation
`drawLine(x1, y1, x2, y2)`	Draws a line segment on a coordinate grid with endpoints at coordinates `(x1, y1)` and `(x2, y2)`

The `drawLine` procedure is to be used to draw the following figure on a coordinate grid.



Which of the following code segments can be used to draw the figure?

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(A)
```
xVal ← 1
yVal ← 0
len ← 1
REPEAT 5 TIMES
{
     drawLine(xVal, yVal, xVal, yVal + len)
     xVal ← xVal + 1
     len ← len + 1
}
```

(B)
```
xVal ← 1
yVal ← 0
len ← 1
REPEAT 5 TIMES
{
     drawLine(xVal, yVal, xVal + len, yVal)
     yVal ← yVal + 1
     len ← len + 1
}
```

(C)
```
xVal ← 5
yVal ← 0
len ← 5
REPEAT 5 TIMES
{
     drawLine(xVal, yVal, xVal, yVal + len)
     xVal ← xVal - 1
}
```

(D)
```
xVal ← 5
yVal ← 0
len ← 5
REPEAT 5 TIMES
{
     drawLine(xVal, yVal, xVal + len, yVal)
     yVal ← yVal - 1
     len ← len - 1
}
```

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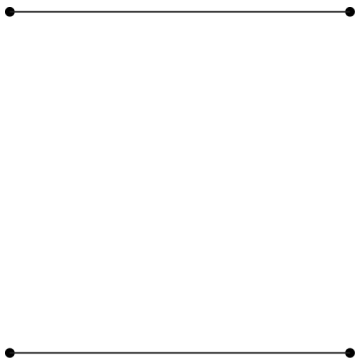
57. Consider the following procedures, which are used to control a device that draws lines on paper.

Procedure Call	Explanation
`penDown()`	Places the device's pen on the paper so that a line is drawn when the device moves
`penUp()`	Lifts the device's pen off of the paper so that no line is drawn when the device moves
`goForward(x)`	Moves the device forward `x` units
`turnRight(x)`	Rotates the device in place `x` degrees clockwise (i.e., makes an in-place right turn)

Consider the goal of using the device to produce the following drawing, where each line shown has a length of 10 units and the horizontal lines are 10 units apart.



The device is positioned at the upper-left corner of a sheet of paper and is facing right. Which of the following code segments will produce the drawing shown?

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(A)
```
penDown()
goForward(10)
turnRight(90)
goForward(10)
turnRight(90)
goForward(10)
```

(B)
```
penDown()
goForward(10)
penUp()
turnRight(90)
turnRight(90)
penDown()
goForward(10)
```

(C)
```
penDown()
goForward(10)
turnRight(90)
penUp()
goForward(10)
turnRight(90)
penDown()
```

(D)
```
penDown()
goForward(10)
penUp()
turnRight(90)
goForward(10)
turnRight(90)
penDown()
goForward(10)
```

58. A student is developing a program that allows users to look up the definitions of words that appear in a book.

The student plans to perform a large number of searches through a dictionary containing words and their definitions. The student will use a procedure written by a computer scientist to quickly search the dictionary (and knows that the procedure will return a definition if one is available). The student cannot modify the search procedure written by the computer scientist but can call the procedure by supplying a word.

Which of the following is a true statement about the student's use of the computer scientist's search procedure?

(A) The student is changing the search procedure's internal abstractions.

(B) The student is modifying the search procedure to take a definition as an argument and return the corresponding word.

(C) The student is reusing the computer scientist's procedural abstraction by knowing what the procedure does without knowing how it does it.

(D) The student is reusing the computer scientist's procedural abstraction by using duplicate code each time a search needs to occur.

59. A large number of genetic codes are stored as binary values in a list. Which one of the following conditions must be true in order for a researcher to obtain the correct result when using a binary search algorithm to determine if a given genetic code is in the list?

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(A) The genetic codes must be converted from binary to decimal numbers.

(B) The list must be sorted based on the genetic code values.

(C) The number of genetic code values in the list must be a power of 2.

(D) The number of genetic code values in the list must be even.

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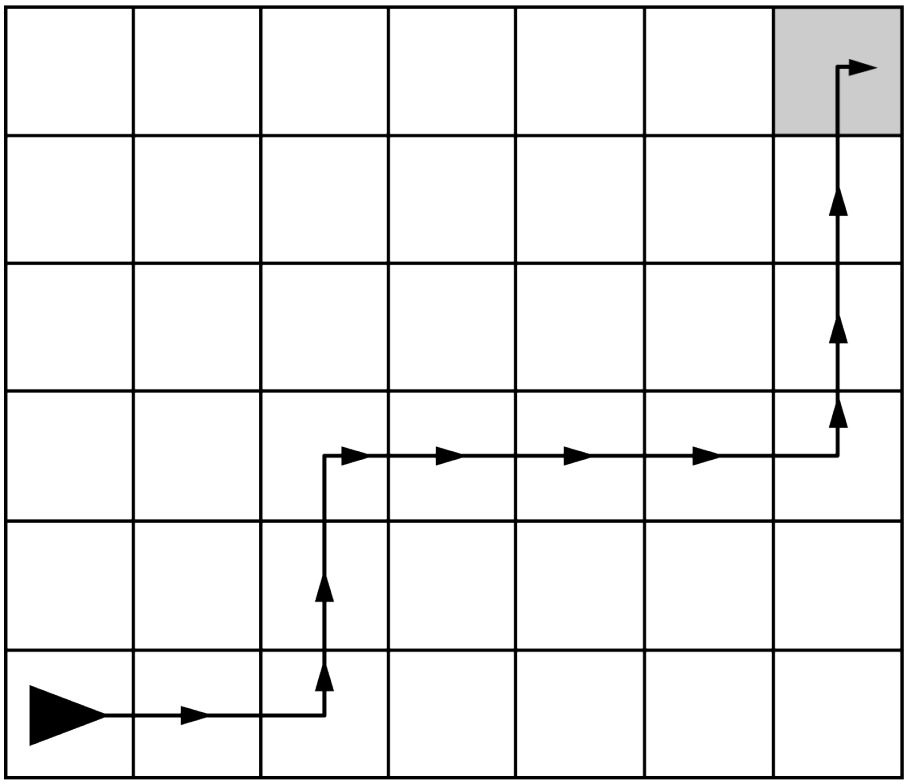
60. The following question uses a robot in a grid of squares. The robot is represented by a triangle, which is initially facing right.



Consider the following procedure.

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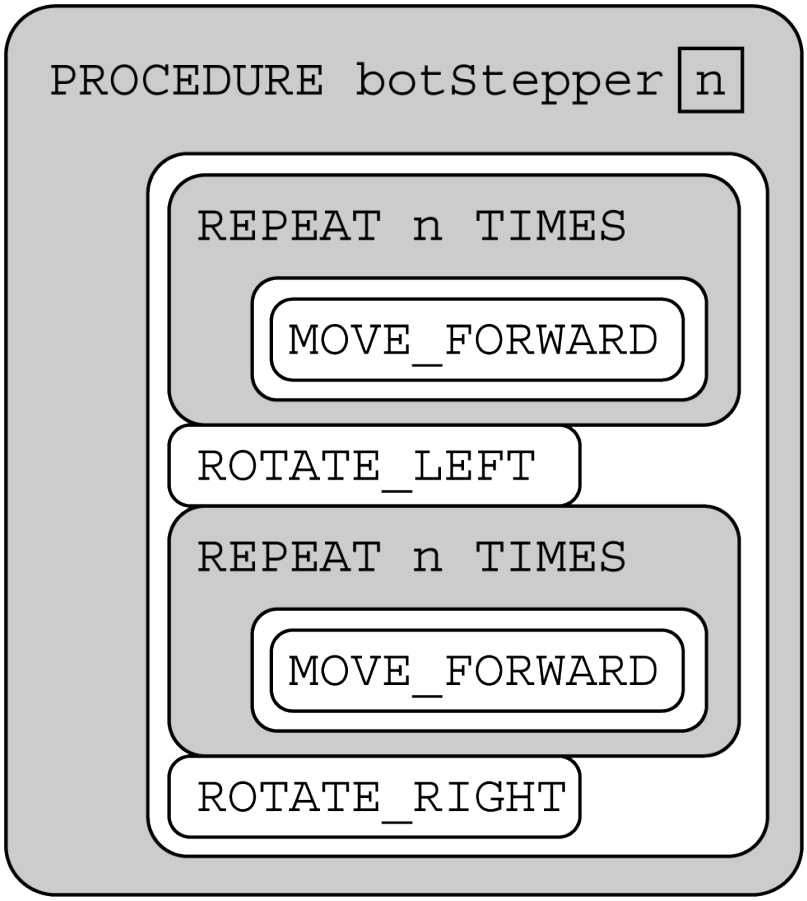

Which of the following code segments will move the robot to the gray square along the path indicated by the arrows?

(A)
```
botStepper 2
botStepper 3
```

(B)
```
botStepper 3
botStepper 4
```

(C)
```
botStepper 2
MOVE_FORWARD
botStepper 3
```

(D)
```
botStepper 3
MOVE_FORWARD
botStepper 4
```

Principles 3.11 3.12 3.13 3.14 3.15 MCQ

61. Consider the following procedure.

```
PROCEDURE doSomething(num1, num2)
{
     DISPLAY(num1)
     RETURN(num1)
     DISPLAY(num2)
}
```

Consider the following statement.

```
DISPLAY(doSomething(10, 20))
```

What is displayed as a result of executing the statement above?

(A) `10 10`

(B) `10 20`

(C) `10 10 20`

(D) `10 20 10`

62. Suppose that a list of numbers contains values `[-4, -1, 1, 5, 2, 10, 10, 15, 30]`. Which of the following best explains why a binary search should NOT be used to search for an item in this list?

(A) The list contains both positive and negative elements.

(B) The elements of the list are not sorted.

(C) The list contains an odd number of elements.

(D) The list contains duplicate elements.