

Code Analysis – Sample Questions

Because the event rules may vary from year to year, these sample questions may address topics not included in the current year's rules.

1. What is the printed output of the following program?

```
// Example1.java

public class Example1
{
    public void one ()
    {
        System.out.println("three");
    }

    public void two ()
    {
        System.out.println("two");
    }

    public void three ()
    {
        one();
    }

    public static void main (String[] args)
    {
        three();
        two();
        one();
    }
}
```

Write your answer below.

/ 15 points

Solution:

```
three
```

```
two
```

```
three
```

Incorrect solutions:

```
threetwothree
```

The printing is not on separate lines. 10 points.

```
one
```

```
two
```

```
three
```

The first line is incorrect. 10 points for the last two correct lines.

```
two
```

```
three
```

```
three
```

Even though all three lines are present, they are in the wrong order. Only the last line counts, 5 points.

Discussion:

This question tests basic knowledge of method calls and printing. It is a simple enough question that all teams should be able to answer (a good exam should have one such question). It also demonstrates one possible way to score the problem. Because the number and order of output lines matter, horizontal writing lines are provided.

2. What is the printed output of the following program?

```
private int a = 5;
private int b = 10;

public static void main (String[] args)
{
    int result = a + b * 4;
    System.out.println(result + 3);
}
```

Write your answer below.

/ 20 points

Solution:

48

Incorrect solutions:

63

This would be the result if expressions were evaluated left-to-right; however, multiplication takes precedence over addition. 5 points.

453

The output should be mathematically added, not concatenated. 5 points.

Discussion:

This question tests integer variables, integer operators, and precedence.

3. What is the printed output of the following program?

```
public static void main (String[] args)
{
    System.out.println(4%8, 14%9, 20%7);
}
```

Write your answer below.

/ 25 points

Solution:

4 5 6

(The last 2 lines should be blank.)

Incorrect solutions:

4

5

6

The printing should not be on separate lines. 15 points.

Discussion:

This question tests the modulus operator and the concatenation operation of `System.out.println`. It also demonstrates that it is not necessary to use every line of the answer space.

4. What is the printed output of the following code fragment?

```
String s = "This is a test.";
int i = 0;
while (i < 10) {
    char c = s[i];
    if (c >= 'a' && c <= 'z')
        c = c - 'a' + 'A';
    else if (c >= 'A' && c <= 'Z')
        c = c - 'A' + 'a';
    System.out.print(c);
    i = i + 1;
}
```

Write your answer below.

/ 25 points

Solution:

```
tHI$ 1S A
```

Incorrect solutions:

```
tHI$ 1S A TEST.
```

The loop executes for only 10 characters, not the full length of the string. 20 points.

```
tHIs iS A
```

The '\$' and 'l' characters are outside the ranges that are tested, and therefore remain unchanged. 20 points.

Discussion:

This question tests knowledge of loops, strings, and character arithmetic. The loop is kept simple for beginning programmers (for example, using `i = i+1` rather than `i++`). Possible variants could include dropping the else, and replacing `>=` with `>`.

5. What is the printed output of the following code fragment?

```
int x = 5;
boolean done = false;
while (!done) {
    System.out.print(x);
    done = (--x < 1);
}
System.out.println(" liftoff!");
```

Write your answer below.

/ 25 points

Solution:

```
54321 liftoff!
```

Incorrect solutions:

```
543210 liftoff!
```

The loop should terminate as soon as `x` becomes 0. 20 points.

Discussion:

This question tests boolean variables, the logical not operator, while loops, and predecrement. Possible variants could include starting with `done = true`, or using a postdecrement.

6. What is the printed output of the following code fragment?

```
int[] fibs = { 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 };
int q = 10;
int lo = 0; hi = 8;
while (lo < hi) {
    int mid = (lo+hi) / 2;
    if (q < fibs[mid])
        hi = mid;
    else
        lo = mid;
}
System.out.println(lo);
```

Write your answer below.

/ 40 points

Solution:

5

Incorrect solutions:

6

When the searched value is between two array values, the program should print the *lower* index.
30 points.

8

Prints the index, not the array value. 30 points.

Discussion:

This is a binary search. It also tests knowledge of arrays.

7. What is the printed output of the following code fragment?

```
String a = "SCIENCE OLYMPIAD";  
String b = a.charAt(a.length - 2);  
String c = a.substring(8, 1);  
String d = a.substring(3, 2);  
String e = d.substring(1, 1).concat(d.substring(0, 1));  
System.out.println(b, c, e);
```

Write your answer below.

/ 25 points

Solution:

DONE

5 points for each letter in any order, plus 5 points for the complete correct order.

Discussion:

This question tests knowledge of string operations.

8. What is the printed output of the code below when it is called as `f(12)`?

```
private int primes[] = { 2, 3, 5, 7, 11, 13, 17, 19 };

public void f (int n)
{
    int i = 0;

    while (i < 8) {
        int d = primes[i];
        if ((n % d) == 0) {
            System.out.printf("%d  ", d);
            f(n/d);
            return;
        }
        i = i + 1;
    }
    System.out.print("\n");
    return;
}
```

Write your answer below.

/ 25 points

Solution:

2 2 3

Incorrect solutions:

2 3

Each time the method is called, it restarts the factor search. 20 points.

Discussion:

This is an example of a recursive method. It also shows how a problem can be specified as a method call – in this case, $f(12)$.

9. What is the printed output of the following program?

```
// Scope.java

public class Scope
{
    private static int x = 1;

    public static void main(String[] args)
    {
        int x = 2;

        System.out.printf("%d ", x);
        a();
        b();
        a();
        b();
        System.out.printf("%d ", x);
    }

    public static void a()
    {
        int x = 3;

        System.out.printf("%d ", x++);
        System.out.printf("%d ", x);
    }

    public static void b()
    {
        System.out.printf("%d ", x);
        x *= 10;
        System.out.printf("%d ", x);
    }
}
```

Write your answer below.

/ 30 points

Solution:

2 3 4 1 10 3 4 10 100 2

3 points per correct answer.

Discussion:

This question tests variable scope. Because a horizontal answer blank is given, the spacing of the answer does not matter.

10. What is the printed output of the following code fragment?

```
private int array[] = { 15, 4, 16, 3, 9, 11, 1, 12, 19, 6 };

int x = 0;
while (x < 9) {
    int y = x+1;
    while (y < 10) {
        if (array[x] > array[y]) {
            int tmp = array[x];
            array[x] = array[y];
            array[y] = tmp;
        }
        y = y + 1;
    }
    x = x + 1;
}

int i = 0;
while (i < 10) {
    System.out.printf("%d  ", array[i]);
    i = i + 1;
}
```

Write your answer below.

/ 40 points

Solution:

1 3 4 6 9 11 12 15 16 19

3 points per number, plus 10 points for the complete correct order.

Discussion:

This is an example of sorting (a bubble sort).

11. What is the printed output of the following program?

```
public void main(){int p=9;q=1,t=0;while(q<p){t+=q;int n=1;
while(n<=q)System.out.print('X');System.out.print('\n');q+=
2;}System.out.printf("%d\n",t);}
```

Write your answer below.

/ 30 points

Solution:

X

XXX

XXXXX

XXXXXXXX

16

[extra lines at the end should be left blank]

5 points for each correct X line, plus 10 points for the correct final total.

Discussion:

This code is "obfuscated". It is intentionally made compact and difficult to read.

12. The following program "paints" and then prints a 10x10 array of characters. Find the printed output.

```
private static char[][] grid = new char[10][10];

public static void initgrid ()
{
    int x = 0;
    while (x < 10) {
        int y = 0;
        while (y < 10)
            grid[x][y++] = '.';
        x++;
    }
    return;
}

public static void
    bresenham (int x0, int y0, int x1, int y1, char ch)
{
    int x = x0, y = y0;
    int dx = x1 - x0, dy = y1 - y0;
    int D = 2*dy - dx;

    // The following code assumes dx > dy > 0.
    do {
        grid[x][y] = ch;
        if (D > 0) {
            D = D - 2*dx;
            y++;
        }
        D = D + 2*dy;
    } while (x++ < x1);
    return;
}

public static void printgrid ()
{
    int y = 0;
    while (y < 10) {
        int x = 0;
        while (x < 10) {
            System.out.print(grid[x][y]);
            x++;
        }
        System.out.print('\n');
        y++;
    }
}
```

```
        return;
    }

    public static void main ()
    {
        initgrid();

        bresenham(1,1, 8,6, '#');

        printgrid();
    }
}
```

Draw your answer below, with one character in each cell. (1 point per character) / 100 points

[illegible]

Solution:

.
.	#
.	.	#	#
.	.	.	.	#
.	#
.	#	#	.	.
.	#	.
.
.
.

Each correctly-drawn cell is worth one point. Any background cells left blank get no credit; they need to be marked with '.'.

Discussion:

This question tests algorithms used for basic computer graphics. Because it takes some time to solve and lends well to partial credit, it makes a good problem to be timed for the tiebreaker. The number and spacing of characters matter, so a grid is given for the answer space.

Code Analysis

Exhibition Event
Wisconsin Science Olympiad State Tournament
UW-Stout, April 1, 2016

Team Name: _____

Team Number: _____

Student Names: _____

DO NOT OPEN THIS TEST until told to do so.

The first question is timed, which may be used to break tie scores. When you are finished with the first question, turn it in immediately to the event supervisor.

Time for question #1: _____

Written test total score: _____ / 100

Tie Breakers: (1) Highest score on question #1, (2) Least time on question #1, (3) Test questions 9, 7, then 11.

1. This first question is timed, which may be used to break tie scores. When you are finished with this question, turn this sheet in immediately to the event supervisor.

What is the printed output of the following program?

```
public void main(){int p=9;q=1,t=0;while(q<p){t+=q;int n=1;
while(n<=q)System.out.print('X');System.out.print('\n');q+=
2;}System.out.printf("%d\n",t);}
```

Write your answer below.

/ 20 points

Solution:

X

XXX

XXXXX

XXXXXXXX

16

[extra lines at the end should be left blank]

4 points for each correct "X" line, plus 4 points for the correct final total.

Discussion:

This code is "obfuscated". It is intentionally made compact and difficult to read.

2. What is the printed output of the following program?

```
// Example1.java
```

```
public class Example1
{
    public void one ()
    {
        System.out.println("three");
    }

    public void two ()
    {
        System.out.println("two");
    }

    public void three ()
    {
        one();
    }

    public static void main (String[] args)
    {
        three();
        two();
        one();
    }
}
```

Write your answer below.

/ 3 points

Solution:

```
three
```

```
two
```

```
three
```

Incorrect solutions:

```
threetwothree
```

The printing is not on separate lines. 2 points.

```
one
```

```
two
```

```
three
```

The first line is incorrect. 2 points for the last two correct lines.

```
two
```

```
three
```

```
three
```

Even though all three lines are present, they are in the wrong order. Only the last line counts, 1 point.

Discussion:

This question tests basic knowledge of method calls and printing. It is a simple enough question that all teams should be able to answer (a good exam should have one such question). It also demonstrates one possible way to score the problem. Because the number and order of output lines matter, horizontal writing lines are provided.

3. What is the printed output of the following program?

```
private int a = 5;
private int b = 10;

public static void main (String[] args)
{
    int result = a + b * 4;
    System.out.println(result + 3);
}
```

Write your answer below.

/ 3 points

Solution:

48

Incorrect solutions:

63

This would be the result if expressions were evaluated left-to-right; however, multiplication takes precedence over addition. 1 point.

453

The output should be mathematically added, not concatenated. 1 point.

Discussion:

This question tests integer variables, integer operators, and precedence.

4. What is the printed output of the following program?

```
public static void main (String[] args)
{
    System.out.println(4%8, 14%9, 20%7);
}
```

Write your answer below.

/ 6 points

Solution:

4 5 6

(3x2 points per digit. The last 2 lines should be blank, else minus 2.)

Incorrect solutions:

4

5

6

The printing should not be on separate lines. 4 points.

Discussion:

This question tests the modulus operator and the concatenation operation of `System.out.println`. It also demonstrates that it is not necessary to use every line of the answer space.

5. What is the printed output of the following code fragment?

```
String s = "This is a test.";
int i = 0;
while (i < 10) {
    char c = s[i];
    if (c >= 'a' && c <= 'z')
        c = c - 'a' + 'A';
    else if (c >= 'A' && c <= 'Z')
        c = c - 'A' + 'a';
    System.out.print(c);
    i = i + 1;
}
```

Write your answer below.

/ 8 points

Solution:

```
tHI$ 1S A
```

(7x1 point per non-space character, +1 for correct number of characters.)

Incorrect solutions:

```
tHI$ 1S A TEST.
```

The loop executes for only 10 characters, not the full length of the string. 7 points.

```
tHI$ iS A
```

The '\$' and 'l' characters are outside the ranges that are tested, and therefore remain unchanged. 6 points.

Discussion:

This question tests knowledge of loops, strings, and character arithmetic. The loop is kept simple for beginning programmers (for example, using `i = i+1` rather than `i++`). Possible variants could include dropping the else, and replacing `>=` with `>`.

6. What is the printed output of the following code fragment?

```
int x = 5;
boolean done = false;
while (!done) {
    System.out.print(x);
    done = (--x < 1);
}
System.out.println(" liftoff!");
```

Write your answer below.

/ 8 points

Solution:

```
54321 liftoff!
```

(5x1 point per digit, +2 points for correct number of digits, +1 for liftoff!)

Incorrect solutions:

```
543210 liftoff!
```

The loop should terminate as soon as `x` becomes 0. 6 points.

Discussion:

This question tests boolean variables, the logical not operator, while loops, and predecrement. Possible variants could include starting with `done = true`, or using a postdecrement.

7. What is the printed output of the following code fragment?

```
int[] fibs = { 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 };
int q = 10;
int lo = 0; hi = 8;
while (lo < hi) {
    int mid = (lo+hi) / 2;
    if (q < fibs[mid])
        hi = mid;
    else
        lo = mid;
}
System.out.println(lo);
```

Write your answer below.

/ 12 points

Solution:

5

Incorrect solutions:

6

When the searched value is between two array values, the program should print the *lower* index.
8 points.

8

Prints the index, not the array value. 8 points.

13

Both of the above mistakes. 4 points.

Discussion:

This is a binary search. It also tests knowledge of arrays.

8. What is the printed output of the following code fragment?

```
String a = "SCIENCE OLYMPIAD";  
String b = a.charAt(a.length - 2);  
String c = a.substring(8, 1);  
String d = a.substring(3, 2);  
String e = d.substring(1, 1).concat(d.substring(0, 1));  
System.out.println(b, c, e);
```

Write your answer below.

/ 8 points

Solution:

DONE

2 points for each letter.

Discussion:

This question tests knowledge of string operations.

9. What is the printed output of the code below when it is called as `f(12)`?

```
private int primes[] = { 2, 3, 5, 7, 11, 13, 17, 19 };

public void f (int n)
{
    int i = 0;

    while (i < 8) {
        int d = primes[i];
        if ((n % d) == 0) {
            System.out.printf("%d  ", d);
            f(n/d);
            return;
        }
        i = i + 1;
    }
    System.out.print("\n");
    return;
}
```

Write your answer below.

/ 12 points

Solution:

$2^2 \cdot 3$

(4x3 points for each term)

Incorrect solutions:

2^3

Each time the method is called, it restarts the factor search. 8 points.

Discussion:

This is an example of a recursive method. It also shows how a problem can be specified as a method call – in this case, $f(12)$.

10. What is the printed output of the following program?

```
// Scope.java

public class Scope
{
    private static int x = 1;

    public static void main(String[] args)
    {
        int x = 2;

        System.out.printf("%d  ", x);
        a();
        b();
        a();
        b();
        System.out.printf("%d  ", x);
    }

    public static void a()
    {
        int x = 3;

        System.out.printf("%d  ", x++);
        System.out.printf("%d  ", x);
    }

    public static void b()
    {
        System.out.printf("%d  ", x);
        x *= 10;
        System.out.printf("%d  ", x);
    }
}
```

Write your answer below.

/ 10 points

Solution:

2 3 4 1 10 3 4 10 100 2

1 point per correct answer.

Discussion:

This question tests variable scope. Because a horizontal answer blank is given, the spacing of the answer does not matter.

11. What is the printed output of the following code fragment?

```
private int array[] = { 15, 4, 16, 3, 9, 11, 1, 12, 19, 6 };

int x = 0;
while (x < 9) {
    int y = x+1;
    while (y < 10) {
        if (array[x] > array[y]) {
            // Swap the values of x and y
            int tmp = array[x];
            array[x] = array[y];
            array[y] = tmp;
        }
        y = y + 1;
    }
    x = x + 1;
}

// Print the array
int i = 0;
while (i < 10) {
    System.out.printf("%d  ", array[i]);
    i = i + 1;
}
```

Write your answer below.

/ 10 points

Solution:

1 3 4 6 9 11 12 15 16 19

1 point per number that is greater than the previous number.

Discussion:

This is an example of sorting (a bubble sort).