

Section I. Multiple Choice Questions (MCQs)

Each MCQ has one correct answer. There is no penalty for wrong answers.

1. What is printed by the following program fragment?

```
double a = (double)5/2;  
double b = 5/2;  
System.out.println("a = " + a + "; b = " + b);
```

- A. a = 2.0; b = 2
 - B. a = 2.0; b = 2.5
 - C. a = 2.5; b = 2
 - D. a = 2.5; b = 2.0
 - E. a = 2.5; b = 2.5
2. Which of the following statements is correct?
- A. A method must contain at least one return statement.
 - B. After a return statement is executed inside a loop, the loop will proceed to its next iteration (if any).
 - C. A return statement may only appear at the end of a method.
 - D. A method may contain any number of return statements.
 - E. A method must take at least one parameter.
3. What is printed by the following program fragment?

```
int a = 500, b = 100, c = 50;  
  
if ( !(a >= 400) ) {  
    b = 300;  
}  
c = 200;  
  
System.out.println("b = " + b + "; c = " + c);
```

- A. b = 300; c = 200
- B. b = 100; c = 50
- C. b = 300; c = 50
- D. b = 100; c = 200
- E. None of the above

4. You are given an unknown method **mystery()** and the table below shows the compilation results for various invocation statements placed within the **main()** method.

Method invocation	Compilation result
<code>System.out.println(mystery(true));</code>	Error
<code>System.out.println(mystery(2, 3));</code>	Error
<code>System.out.println(mystery(8));</code>	OK

Which of the following could be a correct method header of **mystery()** method?

- (i) `double mystery(int x)`
 - (ii) `int mystery(int x, int y)`
 - (iii) `int mystery(double x)`
 - (iv) `void mystery(int x)`
 - (v) `int mystery(boolean x)`
- A. (i) only
 - B. (i) and (iii) only
 - C. (ii) and (iv) only
 - D. (ii), (iii) and (v) only
 - E. (i), (iii) and (iv) only
5. We would like to know if an integer x falls in the range of $-10 \leq x \leq 20$. Which of the following is a correct *if* condition to check it?
- A. `if (-10 <= x <= 20)`
 - B. `if (x >= -10 || x <= 20)`
 - C. `if (-11 < x && 20 >= x)`
 - D. `if (x < -11 && x <= 20)`
 - E. `if (x > -11 && x < 20)`

6. What input will cause the following program fragment to print "Case 4"?

```
if (day <= 5) {  
    if (time <= 8) {  
        System.out.println("Case 1");  
    } else {  
        System.out.println("Case 2");  
    }  
} else if (day == 6) {  
    if (time <= 8) {  
        System.out.println("Case 4");  
    }  
} else {  
    if (time <= 8) {  
        System.out.println("Case 3");  
    } else {  
        System.out.println("Case 4");  
    }  
}
```

- A. day = 6, time = 9
- B. day = 5, time = 8
- C. day = 7, time = 9
- D. day = 7, time = 8
- E. None of the above

7. Assuming that n is a positive integer, consider the following four methods.

```
public static int f1(int n) {  
    int sum = 0;  
    for (int a = 1; a <= n; a++) {  
        sum += a;  
    }  
    return sum;  
}
```

```
public static int f2(int n) {  
    int sum = 0;  
    while (n > 0) {  
        sum += n;  
        n--;  
    }  
    return sum;  
}
```

```
public static int f3(int n) {  
    int sum = 0;  
    do {  
        sum += n;  
        n--;  
    } while (n >= 0);  
    return sum;  
}
```

```
public static int f4(int n) {  
    return n*(1+n)/2;  
}
```

Which of the following statements is TRUE?

- A. Given a positive n , **f1** and **f2** will return different values.
- B. Given a positive n , **f1** and **f3** will return different values.
- C. Given a positive n , **f2** and **f4** will return different values.
- D. Given a positive n , **f3** and **f4** will return different values.
- E. Given a positive n , all the four methods will return the same value.

8. What is printed by the following program fragment?

```
for (int i = 1; i <= 5; i++) {
    switch(i*7%5) {
        case 1:
            System.out.println("*");
            break;
        case 2:
            System.out.print("##");
            break;
        case 0:
        case 4:
            System.out.println("@@@");
            break;
        default:
            System.out.print("++++");
    }
}
```

A.

```
##
@@@
*
++++@@@
```

B.

```
##@@@
*
++++@@@
```

C.

```
##
@@@
*
++++
@@@
```

D.

```
##@@@*
++++@@@
```

E.

```
##@@@
*
++++
```

9. In logic, there is a Boolean operator called the exclusive OR (XOR) which gives the result true if and only if one of the operands is true (see truth table below).

A	B	A XOR B
false	false	false
false	true	true
true	false	true
true	true	false

Which of the following expression is equivalent to the XOR operator?

- A. `(!A || !B)`
 - B. `(!(A && B))`
 - C. `((A && !B) && (!A && B))`
 - D. `((A && B) || (!A && !B))`
 - E. `((A || B) && (!A || !B))`
10. What does the following function compute?

```
// Precond: n >= 0
public static int mystery(int a, int n) {
    for (int i = 1; i <= n; i++) {
        a = a + a;
    }
    return a;
}
```

- A. $2an$
- B. a^n
- C. $2a^n$
- D. 2^na
- E. a^{2n}

11. Suppose `sc` is a `Scanner` object and the user will enter integers in the range $[-100, 100]$, both inclusive, what is printed by the following program fragment?

```
int count = 0;
do {
    int num = sc.nextInt();
    if (num > 0) {
        count++;
    } else {
        break;
    }
} while (count < 10);

System.out.println(count);
```

- A. Read exactly 9 integers from user input. Finally, print out the smallest integer entered by the user.
 - B. Read up to 9 integers from user input and stop reading when a non-positive integer is encountered. Finally, print out the number of positive integers entered by the user.
 - C. Read up to 10 integers from user input and stop reading when a non-positive integer is encountered. Finally, print out the number of integers entered by the user.
 - D. Read up to 10 integers from user input and stop reading when a non-positive integer is encountered. Finally, print out the number of positive integers entered by the user.
 - E. Read exactly 10 integers from user input. Finally, print out the number of positive integers entered by the user.
12. Given two positive integers p and q , under what condition will $p \% q$ be equivalent to $p - q$?
- A. $p < 2q$
 - B. $q \leq p < 2q$
 - C. $q < p \leq 2q$
 - D. $q \leq p \leq 2q$
 - E. None of the above

13. What is the output of the following program?

```
class Q13 {  
  
    public static void main(String[] args) {  
  
        int[] arr = {1, 2, 2, 1, 2, 2, 1};  
  
        for (int i = 4; i <= arr.length; i++) {  
            System.out.print(func(arr, i) + " ");  
        }  
        System.out.println();  
    }  
  
    public static boolean func(int[] arr, int size) {  
  
        for (int i = 0; i < size/2; i++) {  
            if (arr[i] != arr[size-i-1]) {  
                return false;  
            }  
        }  
        return true;  
    }  
}
```

- A. false true false true
- B. false true true false
- C. true false false true
- D. true false true true
- E. true true false true

14. Based on the program fragment below, which of the following statements can be used to replace the code in the box, to produce the same result?

```
int sum = 0;
for (int i = 0; i < n; i++) {
    for (int j = i; j < n; j++) {
        sum++;
    }
}
System.out.println(sum);
```

- A. `sum += i;`
 - B. `sum += n - i;`
 - C. `sum += n;`
 - D. `sum *= n;`
 - E. `sum += n*(n-1)/2;`
15. Consider the following method that counts the number of iterations while executing the loop, given that ($m \leq n$):

```
/* Pre-condition: m <= n */
public static int count(int m, int n) {
    int count = 0;
    for ( ; m < n; m++, n--) {
        count++;
    }
    return count;
}
```

Which of the formulae below (with the **division operator “/” treated as integer divide**) best describes the expected return value from a call to this method, with actual arguments satisfying the pre-condition?

- A. $(n-m)/2 + 1$
- B. $(n-m)/2$
- C. $(n-m+1)/2$
- D. $(n-m)/2 - 1$
- E. None of the above

16. A **Fibonacci** sequence is a series of numbers that begins with 1, 1, 2, 3, 5, 8, In the following program fragment, the output from variable **seq** forms the first 5 terms of a Fibonacci sequence. However, its line 4 hidden from you.

```
1  int i = 1, n = 5, seq = 0, t = 1;
2  while (i <= n) {
3      t += seq;
4      XXXXXXXXXXXXXXX
5      System.out.println("seq = " + seq + " t = " + t);
6      i++;
7  }
```

When executing this code, it prints out the following results:

```
seq = 1, t = 1
seq = 1, t = 2
seq = 2, t = 3
seq = 3, t = 5
seq = 5, t = 8
```

Which one of the following statements can be used in line 4 to produce this output?

- A. **seq -= t;**
- B. **seq = i - 1;**
- C. **seq += i - 1;**
- D. **seq = t - seq;**
- E. None of the above

Section II. TRACING QUESTIONS

Write down output of the following program fragments.

17. What is printed by the following program fragment?

```
System.out.println(9/10);
```

18. What is printed by the following program?

```
class Q18 {  
    public static void main(String[] args) {  
        System.out.println(f(1)+g(1));  
    }  
  
    public static int f(int x) {  
        return 3*x;  
    }  
  
    public static int g(int x) {  
        return f(2*x);  
    }  
}
```

19. What is printed by the following program?

```
class Q19 {  
    public static void main(String[] args) {  
        System.out.println( f(4, 3, 0) );  
    }  
  
    public static int f(int i, int j, int k) {  
        if (i > 0 || j/k < 2) {  
            return j;  
        }  
        return i;  
    }  
}
```

20. What is printed by the following program fragment?

```
double i = 1.5;

switch ( (int)i ) {
    case 1:
        System.out.println(i);
        break;
    case 2:
        System.out.println(i+1);
        break;
    case 3:
        System.out.println(i+2);
        break;
}
```

21. What is the largest value that could be returned by the following method?

```
public static int dothing(int key) {

    int index, arr[] = {2, 6, 4, 8, 10, 12, 10};

    for (index = 0; index < arr.length; index++) {
        if (arr[index] > key) {
            break;
        }
    }

    return index;
}
```

22. What is printed by the following program fragment?

```
int i;
for (i = 1; i < 20; i++) {
    if (i%3 == 0 && i%5 == 0) {
        break;
    }
}
System.out.println(i);
```

23. What is printed by the following program?

```
class Q23 {
    public static void main(String[] args) {
        System.out.println(what(12) + what(90697169));
    }

    public static int what(int num) {
        int count = 0;
        do {
            if (num%10%2 == 1) {
                count++;
            }
            num /= 10;
        } while (num > 0);

        return count;
    }
}
```

24. What is printed by the following program fragment?

```
int count = 0;
for (int i = 1; i < 20; i++) {
    if (i%3 == 0 || i%5 == 0) {
        count++;
    }
}
System.out.println(count);
```

25. What is the output of the following program fragment?

```
int x, y, count;
x = count = 0;
do {
    y = 10 - x;
    while (y > x) {
        count++;
        y -= 2;
    }
    x += 2;
} while (x < 10);

System.out.println("" + x + y + count);
```

=== END OF PAPER ===

Suggested answers

1. D	10. D	19. 3
2. D	11. D	20. 1.5
3. D	12. B	21. 7
4. B	13. C	22. 15
5. C	14. B	23. 6
6. C	15. C	24. 8
7. E	16. D	25. 1029
8. B	17. 0	
9. E	18. 9	

Explanation to selected questions:

Q3:

For the condition `! (a >= 400)` to be true, `a` should be less than 400.

Q4:

Option (iii) is correct because the formal parameter is `double x` and actual parameter in method call `mystery(8)` is 8. So `x` will receive the value 8.0. There is no syntax error as conversion from `int` to `double` is automatic. I have mentioned this at the beginning of lecture 3 video.

Option (iv) is incorrect because the return type cannot be `void`. There must be a return value which will be printed by the `System.out.println()` statement.

Q9:

The first row of the truth table is read as: if `A` is false and `B` is false, then `A XOR B` is false. The rest rows can be read similarly.

Now you filter out options one by one.

For example, for the option `(!A || !B)`, if `A` is false and `B` is false, the expression results in true which is different from the result of the first row of the truth table (which is false).

Q10:

Substitute `a` and `n` with small numbers and filter out options one by one.

For example, the return value of the method should be 12 if `a = 3` and `n = 2`. Hence option `a^n` is wrong (which gives 9), `2a^n` is also wrong (which gives 18) and `a^(2n)` is wrong (which gives 81) too.

Then you use other numbers to test between the remaining two options.

The other way out is: mathematically we can conclude that the method returns $2 \cdot (2 \cdot (2 \cdot \dots \cdot (2 \cdot a) \dots))$ which is $2^n \cdot a$.

Q12:

If p is less than $2q$, it can be re-written as:

$p = q + r$, where $r < q$

Hence, $p - q = r$ and $p \% q = r$.

For example, $5 = 3 + 2$, so $5 - 3 = 2$ and $5 \% 3 = 2$.

On the other hand, p must not be less than q . Otherwise, $p - q$ is negative (which is different from $p \% q$).

Therefore, the correct condition is that $q \leq p < 2q$.

Q13:

The method **func** checks if the given array is a palindrome, from index 0 to index size-1.

According to Wikipedia: a palindrome is a word, number, phrase, or other sequence of characters which reads the same backward as forward, such as madam, racecar.

Knowing the logic of the method makes tracing much faster because you can manually check palindromes instead of tracing the program line by line.

Q21:

If $key \geq 12$, return value of the method will be 7.