Question 1a)

What is printed by the following Java program?

```java
int s;
int r;
int i;

int [] x = {4, 8, 2, -9, 6};
s = 1;
r = 0;
i = x.length - 1;
while (i > 0)
{
    s = s * -1;
i = i - 1;
    r = r + s * x[i];
}
System.out.println(r);
```

a) -13  b) 20  c) -9  d) -21  e) 11  f) 7

---

Trace of program

<table>
<thead>
<tr>
<th>x</th>
<th>s</th>
<th>r</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>{4, 8, 2, -9, 6}</td>
<td>(4, 8, 2, -9, 6)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>s = 1</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>r = 0</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>i = x.length - 1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>while (i &gt; 0): true</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s = s * -1</td>
<td>-1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>i = i - 1</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>r = r + s * x[i]</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>while (i &gt; 0): true</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s = s * -1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>i = i - 1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>r = r + s * x[i]</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Trace of program

<table>
<thead>
<tr>
<th>x</th>
<th>s</th>
<th>r</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4, 8, 2, -9, 6)</td>
<td>1</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>while (i &gt; 0): true</td>
<td>s = s * -1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i = i - 1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>r = r + s * x[i]</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>while (i &gt; 0): true</td>
<td>s = s * -1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i = i - 1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>r = r + s * x[i]</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>while (i &gt; 0): false</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(r)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Question 1a)

What is printed by the following Java program?

```java
int s;
int r;
int i;

int [] x = {4, 8, 2, -9, 6};
s = 1;
r = 0;
i = x.length - 1;
while (i > 0)
{
    r = -(9) + 2 - 8 + 4
    s = s * -1;
i = i - 1;
r = r + s * x[i];
}
System.out.println(r);
```

a) -13  b) 20  c) -9  d) -21  e) 11  f) 7
Question 1b)

The array of integers "a" (type int) initially contains {1, 3, 8}. Only one of the following Boolean expressions evaluates to false. Circle the letter next to the expression that evaluates to false.

a) \( (a[1] < 3) \lor ( (a[1] / 2) == 1) \)

b) \( !((a[0] \% a[2]) == (a[0] \% a[1]) ) \)

c) \( !(false) \&\& (a[2] < a[1]) \)

d) \( Math.pow(a[1],2) > a[2] \)

e) \( Math.abs(a[0] - a[1] + 2) \leq 0 \)
Question 1b)

• The array of integers "a" (type int) initially contains {1, 3, 8}. Only one of the following Boolean expressions evaluates to false. Circle the letter next to the expression that evaluates to false.

\[
\begin{array}{c|c|c}
\text{1} & \text{8} & \text{1} \text{ 3} \\
\end{array}
\]

b) \( \neg (a[0] \% a[2]) == (a[0] \% a[1]) \) 

\[
\begin{array}{c|c|c}
\text{T} & \text{1} & \text{1} \\
\end{array}
\]

c) \( \neg (!\text{false} \&\& (a[2] < a[1]) \) 

\[
\begin{array}{c|c|c}
\text{T} & \text{F} & \text{F} \\
\end{array}
\]
Question 1b)

- The array of integers "a" (type int) initially contains \{1, 3, 8\}. Only one of the following Boolean expressions evaluates to false. Circle the letter next to the expression that evaluates to false.

\[
\begin{align*}
3 & \quad 8 \\
\text{d) Math.pow(a[1], 2) > a[2]} & \quad 9 \\
\text{e) Math.abs(a[0] - a[1] + 2) \leq 0} & \quad -2 \quad 0 \quad \text{T}
\end{align*}
\]
Question 1b)

- The array of integers "a" (type int) initially contains \{1, 3, 8\}. Only one of the following Boolean expressions evaluates to false. Circle the letter next to the expression that evaluates to false.

  a) \((a[1] < 3) || (a[1] / 2) == 1\)
  b) \(!(a[0] \% a[2]) == (a[0] \% a[1])\)
  c) \(!(false) \&\& (a[2] < a[1])\)
  d) \(Math.pow(a[1], 2) > a[2]\)
  e) \(Math.abs(a[0] - a[1] + 2) <= 0\)

Question 1c)

- Suppose that X and Y are given integers; C and D are intermediates; A and B are results. What will the values of A and B at the end of this algorithm, if the initial values are X = 8 and Y = 3?

```
C ← 0
D ← X
Y ≤ D?
true
false
A ← C
B ← D
A ← C
B ← D
C ← C + 1
D ← D - Y
```

```
Trace of algorithm

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>C</th>
<th>D</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial values</td>
<td>8</td>
<td>3</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>C ← 0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D ← X</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y ≤ D : true</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D ← D − Y</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C ← C + 1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y ≤ D : true</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D ← D − Y</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C ← C + 1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A ← C</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B ← D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Question 1c)

• Suppose that X and Y are given integers; C and D are intermediates; A and B are results. What will the values of A and B at the end of this algorithm, if the initial values are X = 8 and Y = 3?

This algorithm calculates $A = \frac{X}{Y}$ and $B = X \% Y$

$A = 2, B = 2$
Question 2a) while ( x < length )
{
  y = 0;
  if ( y < length )
  {
    y = y + 1;
  }
  else
  {
    x = x + 1;
  }
}
z = z + 1;

Briefly, this translation of an algorithm body diagram is incorrect because ...

A loop has been translated as an if-else statement.

Correct translation
Question 2b)

Briefly, this algorithm body diagram is incorrect because ...

A loop block always has the loop return to the test. This could not be translated to Java.

Corrected
Question 3) Translate to Java

GIVENS:  
X (array of integers)  
N (number of items in array X)  
V (a limit value)

INTERMEDIATES:   
Index (index for array X going from 0 to N-1)  
Sum (sum of values in the array)

RESULT:   
Exceeds (Boolean: True if Sum > V and false otherwise)

HEADER: Exceeds ← SumExceedsV( X, N, V )

---

Question 3 (first part)

```java
import java.io.*;

class exam2004Q3 {
    public static void main( String[] args ) throws IOException {
        // DECLARE VARIABLES / DATA DICTIONARY
        int[] x;  // GIVEN: array of integers
        int n;  // GIVEN: number of items in the array x
        int v;  // GIVEN: a limit value
        int index;  // INTERMEDIATE: index for array x
        int sum;  // INTERMEDIATE: sum of values in array x
        boolean exceeds;  // RESULT: true if sum > v and false otherwise

        // READ IN GIVENS
        System.out.print( "Enter an array of integers: " );
x = CSII100.readIntLine( );
n = x.length;

        System.out.print( "Enter a limit value: " );
v = CSII100.readInt( );
```
Question 3 (second part)

// BODY OF ALGORITHM
index = 0;
sum = 0;

while( index < n && sum <= v )
{
    sum = sum + x[index];
    index = index + 1;
}

exceeds = (sum > v);

// PRINT OUT RESULTS AND MODIFIEDS
System.out.println( "The result is: " + exceeds );
Question 4: Algorithm

- The Canadian income tax system has a series of tax brackets, where if a person's annual income is greater than or equal to the lower limit for the tax bracket, and less than the upper limit, the person is contained within the tax bracket.

- Suppose that you are given the upper and lower limits for a single tax bracket for a specific year, and an array Income of length NumPersons where each entry is the annual income for some person. Write an algorithm to determine the percentage of people that are contained in the tax bracket.

Question 4)

GIVENS: Lower (Tax bracket lower limit) Upper (Tax bracket upper limit) Income (Array of annual incomes) NumPersons (Size of array Income)

INTERMEDIATES: Index (Index for the Income array) Count (Number of people in the tax bracket)

RESULT: Percentage (Percentage of incomes within the tax bracket [0-100])

HEADER: Percentage ← PctInBracket (Lower, Upper, Income, NumPersons)
Question 4)

BODY:

```plaintext
Index ← 0
Count ← 0

Index < NumPersons ?
false

(Income[Index] ≥ Lower) AND
(Income[Index] < Upper) ?
false

Percentage ←
Count / NumPersons *100

true

Count ← Count + 1
Index ← Index + 1
```

```plaintext
true

Count ← Count + 1
Index ← Index + 1
```