1. Number systems.

(a) 173_{10}
(b) 31. The last integer printed is $2^{30}$ because $2^{30} + 2^{30}$ overflows an int and results in $-2^{31}$.

2. Java basics.

(a) 

<table>
<thead>
<tr>
<th>Java expression</th>
<th>type</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 + 2.0 * 3 + 4.0</td>
<td>double</td>
<td>11.0</td>
</tr>
<tr>
<td>(-1 / -1) / 0</td>
<td>runtime error</td>
<td>–</td>
</tr>
<tr>
<td>(-1.0 / -1.0) / 0.0</td>
<td>double</td>
<td>positive infinity</td>
</tr>
<tr>
<td>Math.sqrt(-2.0)</td>
<td>double</td>
<td>NaN</td>
</tr>
<tr>
<td>1 + &quot;+&quot; + 2.0 + &quot;3&quot;</td>
<td>String</td>
<td>&quot;1+2.03&quot;</td>
</tr>
<tr>
<td>(double) (10 / 4)</td>
<td>double</td>
<td>2.0</td>
</tr>
<tr>
<td>(1.0 &lt;= 2.0 &lt;= 3.0)</td>
<td>compile-time error</td>
<td>–</td>
</tr>
</tbody>
</table>

(b) i, iii, iv, v

3. Loops, conditionals, and arrays.

(a) 0.5
(b) The smallest difference (in absolute value) between any two values in a[]; infinity if no such value.

4. Input and output.

The programs prints out the first number, and then the average (integer division) of each number and its predecessor.

(a) 2 3 5 7 9 11 10 5.
(b) 2 2 4 6 8 10 10 7.
5. Functions.

(a) public static int gcd(int p, int q, int r) {
    return gcd(gcd(p, q), r);
}

(b) public static int gcd(int[] values)

6. Recursive graphics.

(a) 1 4 5 2 6 3 (the unique ordering)

(b) I and III only

- The drawShadedSquare() must appear after the lower left and upper right calls because the order 5 square obscures the order 4 recursive patterns in the lower left and upper right; it must appear before the upper left and lower right calls because the order 4 squares are obscured by the order 3 patterns in the upper left and lower right.
- The lower right call must appear before the upper left call because the order 4 pattern is started in the lower right but the order 4 pattern has not yet begun in the upper left.
- The upper right call must appear before the lower left call because of the unfinished order 3 pattern (that is the lower left part of the lower right order 4 pattern).

7. TOY.

(a) 0002 and 0008
(b) 000B and 0010
(c) a = a % b;