Name: _____

Directions: Work only on this sheet (on both sides, if needed); do not turn in any supplementary sheets of paper. There is actually plenty of room for your answers, as long as you organize yourself BEFORE starting writing. In order to get full credit, SHOW YOUR WORK.

1. (15) In the Tetris game, the macro _____ and the subroutine _____ do work which is similar to the %d portion of the **print()** subroutine you wrote for Homework V.

2. (15) At the end of the game Tetris, the first digit of the score will be written at row _____ and column _____ of the screen. (Your answers must be numbers, not symbols.)

3. (15) We have a method whose declaration begins with

```
private int q(int a, int b)
{  int x,y;
```

The following JVM byte code begins at offset 28: 1c 08 a2 00 4b. *Disassemble* these instructions, i.e. give the corresponding JVM assembly language.

4. (15) In our PLN unit on the JVM, Thomas Fifield shows some "unnatural" compiled code and then compares it with the "natural code," pointing out that the latter produces longer code. In terms of program size, the "natural" code uses _____ more bytes than the "unnatural" code. (Answer with a positive, negative or zero integer.)

5. (20) The source code

```
N.Next = this;
```

on line 37 of p.12 of our PLN unit on the JVM compiles to the instructions in offsets _____ through _____.

6. (20) Suppose a program occupies just two pages, for the **.data** and **.text** segments. The **.data** segment has virtual page number 0x22 and physical page number 0x188. The corresponding values for the **.text** segment are 0x23 and 0x6, respectively. The page table begins at 0x20000. Assume the structure on p.17 of our PLN unit on OS, with bits 7-0 always containing 0s. Then the page table entry for the **.data** segment is in word _____, with the entry value being _____, and the entry for the **.text** segment is in word _____, with the entry value being _____ Give your answers in hex.

Solutions:

1. twodigits, **numbertostring**

2. See the lines following **gameover**, and in the Makefile. The string "Loser" is written at row 19, column 0, so the score will be written at row 20, column 8.

3.

```
iload_2
iconst_5
if_cmpge 105
```

4. 3

5. 86, 88

6. First entry is at 0x20000 + 4*0x22 = 0x20088. The page is resident (since it has a physical address), readable and writable, but not executable. The entry is thus 0x00188e00. The second entry is at 0x2008c and contains 0x00006d00.

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