

## Tutorial 5

1. Please complete the following table with instructions used for each operation.

Instructions	Registers	Stack	Memory		I/O	
			Data	Program	Separate	Mapped
Initialize						
Write to						
Read from						

2. How do you setup a port to act as an input port or as an output port in AVR? What instructions are used to read from an I/O port? What instructions are used to write to an I/O port?

3. Consider the following example AVR code segment:

```

Address
0x1000      .def grade=r20
0x1002      .include "m64def.inc"

0x1004      LDI r29,high(RAMEND)
0x1006      LDI r28,low(RAMEND)
0x1008      OUT SPH,r29
0x100A      OUT SPL,r28
0x100C      LDI r18,45
0x100E      RCALL GRADE_CAL
end:
0x1010      RJMP end
GRADE_CAL:
0x1012      PUSH r29
0x1014      PUSH r28
0x1016      CPI r18,50
0x1018      BRGE gradel
0x101A      LDI grade,2
0x101C      RJMP exit
gradel:
0x101E      LDI grade,1
exit:
0x1020      POP r28
0x1022      POP r29
0x1024      RET

```

What are the values of r28, r29, SPL and SPH:

- after line "LDI r28,low(RAMEND)"?
- after line "OUT SPL,r28"?
- after line "BRGE gradel"?

d) after line "POP r29"?