Bresia Prudente
bprude2

1. bubble.ys

Array Size	Number of Cycles
7	226
8	304
9	392
10	490
11	598

bubblecmov.ys

Array Size	Number of Cycles
7	270
8	360
9	464
10	582
11	714

The bubble.ys version performed better than bubblecmov.ys because the arrays have a smaller number of elements. It ran faster since the assembler has less elements to process (i.e. there were less instructions).

2.

a) #1

```
irmovl $5, %eax          F D E M W
irmovl $10, %ebx           F  D E  M W
irmovl $15, %ecx             F  D  E  M W
rrmovl %ebx, %eax              F   D  E  M W
halt
```

#2

```
irmovl $4, %ecx          F D E M W
irmovl %eax, %ebx          F  D E  M W
irmovl $24, %edx             F  D  E  M W
addl %ebx, %edx                F   D  E  M W
halt                             F   D  E  M W
```

#3

```
subl %eax, %ebx          F D E M W
irmovl $7, %ecx            F  D E  M W
rrmovl %ecx, %edx            F  D  E  M W
irmovl $8, %edx                F   D  E  M W
halt                             F   D  E  M W
```

b) A stall is unavoidable when it processes returns and during load/use hazards.

```
# Processing ret
# S = stall
irmovl Stack, %eax          F D E M W
call proc                     F D E M W
ret                             F D E M W
addl %eax, %ecx                   F  S S  D E M W       # not executed because of stall
mrmovl 5(%ecx), %edx                    F D E M W

# Load hazard
# S = stall
irmovl $5, %eax             F D E M W
irmovl $10, %ebx              F D E M W
irmovl $15, %ecx                F D E M W
irmovl $20, %edx                  F D E M W
addl %eax, %ebx                     F D E M W
mrmovl 5(%ecx), %edx                  F D E M W
subl %edx, %eax                         F D S E M W
halt                                      F S  D E M W
```