| **NUMBER OF STAGE** |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IF** | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 |  |  |  |  |
| **ID** |  | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 |  |  |  |
| **EXE** |  |  | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 |  |  |
| **MEM** |  |  |  | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 |  |
| **WB** |  |  |  |  | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 |
| **Clock cycle TIME** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |

Examples pipeline:

1.

Suppose there are 8 instruction in a program.

There ae 5 stages in pipeline: IF,ID,EXE,MEM,WB. CPI= 12/8=1

K=number of stages

n= number of instructions total time for pipeline implementation: 5\*1+(8-1) =5+7=12cc

for nonpipelined: 5\*1\*8=40cc

K\*1+(n-1)

CPI= total clock cycle/total number of instructions

Speedup = total time in nonpipelined/total time in pipeline

=40/12=?

Efficiency: total block in table/ total used block = 60/40=?

2. Consider a non-pipelined machine with 6 execution stages of lengths 20 ns, 20 ns, 30 ns, 30 ns, 20 ns, and 20 ns. 

i) -  Find the instruction latency on this machine.

Ans: instruction latency= (20+20+30+30+20+20) ns=140ns

ii) -  How much time does it take to execute 77 instructions?

Ans: time to complete 77 instructions: 140\*77=10780ns.

iii) Suppose we introduce pipelining on this machine. Assume that when introducing pipelining.

      - What is the instruction latency on the pipelined machine?   
      - How much time does it take to execute 77 instructions?

Also calculate the speedup

Latency for pipelined: 30ns\*6=180ns

Time for 77 instructions in pipelined: (30\*6)+(76\*30)=2460ns

Speedup= total time for nonpipelined/total time for pipeline=10780ns/2460ns=4.3.

FOR nonpipelined:

Instruction latency: 20+20+30+30+20+20=140ns

Time for 77 instructions: 140ns\*77=10780ns

For pipelined:

Instruction latency: 30\*6=180ns

Time 77 instructions:180+30\*77=180+2310=2490ns

Speedup= 10780/2490=4.32

30\*4+(n-1)30

120+90=210

480

i)Speed up= 480/210=

60\*4+(4-1)60

240+180=420

480/420=

0H LDA 9H;

9H 0AH;

600 for non pipelined;

(4\*30)+(5-1)30;

= 120+120=240 pipelined;

Nonpipelined/pipeline= 600/240

4\*60)+4\*60

480

Speed up = 600/480

0H LDA 9H;

1. ADD 4H;

9H 0A;