1	Date
lomew	rk 3 5 por so to so you at the contract to
. a)	pipeline: 350 ps. The longest stage is ID, it takes 350 ps.
n	on-pipeline: 1250ps. A clock cycle include 5 stages.
	pipeline: 1250 ps. Iw should take all 5 stages, so no matter pipeline
	or not, it will both take 1250ps.
y	on-pipeline: 1250 ps.
c)	Ve cut the longest stage ID, then the longest will be MEM.
	t takes 300 ps, so the new clock cycle should be 300 ps.
	load and store use data memory. 20%+15%=35%
e)	ALU/Logic and Load need write back. 45% + 20% = 65%
	clock cycle times:
e i taur	- single - cycle: 1250 ps
	- multi-cycle: 350 ps
	- pipeline: 350 ps
	execution times:
	- single-cycle: 1250 ps per instruction 1400ps 1400ps 1050ps 1750ps 1750ps 1750ps 1750ps 1750ps 1750ps 1750ps 1750ps
	- multi-cycle: 45% × + 00% × + 00% ×
*	= ps per instruction
	-pipeline: 350 ps per instruction
	Before, need (n+4n)-250 ps = 1250 n ps
a)	After, need $(n+0.05n) \cdot 300ps = 315n ps$
	After, new (17 0.05.1)
	speedup = $\frac{1250 n}{315 n} = 3.97$ $(1+x) \cdot 250 = 1 \Rightarrow x = 0.26$ b) $\frac{(1+4) \cdot 250}{(1+x) \cdot 300} = 1 \Rightarrow x = 3.17$
-b)	$\frac{(1+2)\cdot 300}{(1+0.05)\cdot 300} = 1 \Rightarrow x = 0.35$ 3.17n NOPs can remain.
	-Only-
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3. a)	cci ccz cc3	CC4 CC5	cc6	CC7	cc8 cc9	CC10 CC	11 CCIZ
SW x29, 12(x16)	18	Peg	140	The	30 055	: Smil squa	181
lw x29, 8(x16)	THE P		19	S. A.	10581:	Sallage - Da	
sub x17, x15, x14.	12	PE	DM	60	39 43 5	: anilogia	(8)
		00	Œ	€3 €	3	. tore to	
		Ø	\mathcal{E}	€ €	3 63	daniq-wa	1
begz x17, label	en the lonnest	rit di	1		DM	Reg	Lia
add XIS, XII, XI4		Jools ws	in ske	M-194		M	
Sub x15, x30, x14	5= 75.51 + 4,04	. Moltes a	, state		-IRE	M-	
b) No. If w	ve put load o	and store	e at	the e	nd, th	nere will	be
	blems about l					a stock c	(+
c) No. MOP	is "addi zero,	zero, o",	it s	till n	eeds f	etch inst	ruction

	EX MEM WB												
bne x12, x13, Top IF	ID EX MEM WB												
SH: x5, x12, 2	IF ID EX MEM WB												_
add x6, x10, x5	15 7h 51						200						_
lw x7.0(x6)	IF ID EX MEM W	VB EM WB							_				_
lw x29, 4(x6)	IF ID EX	MEM W	В										_
sub ×30, ×7,×29	1F ID	EX MEA	l WE										_
add x31, x11, x5													_
Sw ×30,0(×31)	4	LD EX											
addi x12, X12, 2		IF ID											
412, 112, 113, 40P				71471	***								
bne x12, x13, TOP		IF	ID	EX	MEM	WB							
slli x5, XI2, Z			16	75	~								
			LF.	ZD	EX	MEM	WB						
add x6, x10, x5 lw x7, 0(x6)				ΙF	ZD	ΕX	MEM	W/R					
W X1,0(X6)					if	ID	EX	MEM	WB				
lw x4,4(x6)							75						
						4	LD.	EX	MEM	wB			
Sub x30, x7, x29													
							IF	LD	EX	MEM	WB		
add x31, x11, x5								71-	71	D 4	M =		
SW x30, 0(x31)							-	IF_	1F	ID	MEM	MEM	WR
ddi x12, x12, Z									IF	ID	0.5	MEM	
one x12, x13, TOP												,,,,,,,,	
		^								IF	ID	EX	MEM W
b) For one-issu	ie a loop need	c 82 -	l.	^	_	,				,		1.	a
0110 1221	ic, a loop need	3 W L	ycle	S.	ror	tu	0-1	SSU	2. 6	1 100	D ne	eds_	D

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	Date
c) begz x13, OUT	
•	
jal ENT	
TOP: 版 ×7.0(×10)	
lw a	
sub x30, x7, x29	
SW x30,0(x11)	
addi x12, x12, 2	
add: x10, x10, 48	
add: x11, x11, 48	
and: Air, Air,	
ENT: bne X12, X13, TOP	
OUT:	
d) beg x13, DONE	
(i ×12,0	
TOP: 10 (w x7, 0(x6)	
TOP: (w x/, 0(x))	
add: ×12,×12,2	
0 "(~() SW X30, 0(x31)	
w x27, 4(ND) bne x12, x13, TOP	
addi x6, x6, 8	
7 439	
Sub x30, x1, x2	ue needs 6 cycles a lec
sub $\times 30$, $\times 7$, $\times 29$ e) One-issue needs 8 cycles a loop, two-iss	
e) One-issue needs $\frac{8}{6} = 1.33$ Speedup is $\frac{8}{6} = 1.33$	
Speedup is 6	
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