Class	P1	P2	weight
A	1	2	0.1
B	2	2	0.2
C	3	2	0.5
D	3	2	0.2
CPI Rate	2.5	3	

$$P1 CPI = \frac{\%2 \text{ CPI} \cdot \text{times}}{\text{I Count}} = \frac{0.1 \cdot 1 + 0.2 \cdot 2 + 0.5 \cdot 3 + 0.5 \cdot 3}{\text{Ratio}}$$

$$= 0.1 + 0.4 + 1.5 + 1.5$$
$$= 3.5 \text{ CPI}$$

$$P2 CPI = 2 \cdot 0.1 + 2 \cdot 0.2 \; 2 \cdot 0.5 \cdot 2 \cdot 0.2$$
$$0.2 + 0.4 + 1 + 0.4$$
$$= 2$$

$$P1 = \frac{I \cdot 3.5}{} = 3.5 \times 10^6 \text{ cycles}$$

$$P2 = I \cdot 2 = 2 \times 10^6$$

P2 is faster because it has fewer CPI and a faster ClockSpeed

2.)

A	B
$I = 1 \times 10^9$ instruction	$I = 1.2 \times 10^9$
CPUT = 1.1 sec	CPUT = 1.5 sec

Clock cycle = 1 ns

a. $CPUT = I \times CPI \times CC$

$$CPI = \frac{CPUT}{I \cdot CC}$$

$$CPI = \frac{10^9 \cdot CPUT\,ns}{10^9 \cdot I_{inst} \cdot 1c} = \frac{CPUT}{I}$$

$$A = \frac{1.1}{1} = 1.1 \text{ cpi}$$

$$B = \frac{1.5}{1.2} = 1.25 \text{ cpi}$$

b. units cancel

$$CT \cdot Ic \cdot CPI = CT \cdot Ic \cdot CPI$$

$$CT_0 \cdot 1 \cdot 1.1 = CT_1 \cdot 1.2 \cdot 1.25$$

$$CT_0 = CT_1 \cdot 1.36$$

$$1.5 = CT_1 \cdot 1.5$$

$CT_1 = 1ns$; $CT_0 = 1.36ns$

B A

c. Ex time = $I \times CPI \times CT$

$= 6.0 \times 10^8 \times 1.1 \times 10^{-9}$

$= 6.6 \times 10^{-1} = 0.22$ sec

Speedup A-C $= \frac{1.1}{0.22} = 5X$

3.)

	P1	P2
CT	4 GHz	3 GHz
CPI	0.9	0.75
I	5×10^9	1×10^9

a.)

P1 $ET = \frac{5 \cdot 0.9 \cdot 10^9 \cdot 4}{10^9} = 18$ sec

P2 $ET = \frac{1 \cdot 0.75 \cdot 3 \cdot 10^9}{10^9} = 2.25$ sec

Performance p1 = 0.055

Performance p2 = 0.4

not True

6. $E_{t_{P1}} = 0.9 \cdot 4 \cdot \frac{10^9}{10^1} = 3.6 \text{ sec}$

$3.6 = \frac{3 \cdot 0.75 \, I_{P2}}{10^{-9}}$

$I_{P2} = 1.6 \times 10^9$

4.

	L
IF	250 ps
ID	350 ps
EX	150
mem	300
WB	200

Instructions	
Alu	0.545
beq	0.2
lw	0.2
sw	0.15

a. They are the same
150 ps

b. Single cycle = 6(6) 1250 ps
Same for pipeline ~~unless~~

C. the EX Stage and the new time is 75

D. sw + lw

Utilization = LW + SW = 0.35

e.) alu + lw

Util = 0.45 + 0.2 = 0.65

f.)

Clock cycle times all the same

Pipeline = CT · I · IF + (IF + ID + EX + Mem)

= CT · I · 250 + 800

multi = CT · I · (0.45 (IF + ID + EX) 750
+0.2 (IF + ID + EX) 750
+0.2 (IF + ID + Mem) 900
+0.15 (IF + ID + Mem) 900

= CT · I · 802.5

Single cycle = CT · I · (IF + ID + EX + M

= CT · I · 1050