1 1.6

class A = 10,
class B = class D = 20,
class C = 50,
IC = 10^6

	Clock Rate	CPI Class A	CPI Class B	CPI Class C	CPI Class D
P1	2.5GHZ	1	2	3	3
P2	3GHZ	1	2	3	2

1.0.1 a

CPI(P1)= (CPU*clock rate)/IC.
CPU(P1) = $\sum[(IC * CPI)/clockrate]$
=[[10^6 *((0.1*1)+(0.2*2)+(0.5*3)+(0.2*3))]/[2.5*10^9]] =(2.6)/2.5*10^3=1.04ms,
$\implies$ CPI(P1) = (1.04 * 2.5 * 10^9)/(10^6 * 10^3) =2.6*10^6 /10^6=2.6.

CPI(P2)= (CPU*clock rate)/IC.
CPU(P2)= $\sum[(IC * CPI)/clockrate]$
=[[10^6 *((0.1*2)+(0.2*2)+(0.5*2)+(0.2*2))]/[3*10^9]] =(2)/3*10^3
=0.67ms $\implies$ CPI(P2) = (0.67 * 3 * 109)/(106 * 103) =2.01

1.0.2 b

Clock Cycle(P1)= CPI*IC = 2.6*10^6.
Clock Cycle(P2)= CPI*IC = 2.01*10^6.

2 1.7

Execution Time (A)=1.1s IC(A)=10^9
Execution Time (B)=1.51s IC(B)=1.2*10^9
Clock Time =1/10^9s.

2.0.1 a

CPI=(Execution Time)/(IC*Clock Time)
$\implies$ CPI(A)=(1.1*10^9)/(1*10^9)=1.1
$\implies$ CPI(B)=(1.5*10^9)/(1.2*10^9)=1.25

2.0.2 b

ExecutionTime(A)= IC x CPI x ClockCycleTime(A)
=1 * 10^9 * 1.1 * ClockCycleTime(A)
ExecutionTime(B)= IC x CPI x ClockCycleTime(B)
=1.2 * 10^9 * 1.25 * ClockCycleTime(B)
ExecutionTime(B)= ExecutionTime(A)
1 *10^9 *1.1 * ClockCycleTime(A) = 1.2 * 10^9 * 1.25 * ClockCycleTime(B)
ClockCycleTime(A) = (1.5/1.1) * (ClockCycleTime(B))
ClockCycleTime (A)=1.36 * (ClockCycleTime(B))

2.0.3 c

newIC= 6x10^8
newCPI= 1.1 CPU
newExecutionTime =IC * CPI * Clock cycle time =(6 * 10^8 ? 1.1)/109= 0.66 secs

For A: newExecutionTime(A) = 1.1 secs.
Speed = ExecutionTime(A)/newExecutionTime
speed=1.67.

For B: newExecutionTime(B) = 1.5 secs.
Speed = ExecutionTime(B)/newExecutionTime
speed=2.27.

3 1.9

CPI(Arithmetic) = 1.
CPI (Load/store) = 12.
CPI (Branch) =5.
IC(Arithmetic) =2.56x10^9
IC (Load/store) =1.28x10^9
IC (Branch) 256x10
Cock Rate =2 GHz

3.1 a

ExecutionTime =ClockCycle/ClockRate
Clock Cycles= CPI(Arithmetic) *IC(Arithmetic) + CPI(Load/store)*IC(Load/store)
+CPI(Branch)*IC(Branch).

3.1.1 1

ExecutionTime(1):

ClockCycles(1)=2.56 * 10^9 + 1.28*10^9 * 12 + 256*10^6*5=19.2*10^9cycles

ExecutionTime(1)=ClockCycle/ClockRate = 19.2*10^9cycles/2*10^9cycle/secs
=9.6secs

3.1.2 2

ExecutionTime(2):

ClockCycles(2) = CPI(Arithmetic)* IC(Arithmetic)/ 0,7*p + CPI(Load/Store)
*IC(Load/Store) / 0,7*p +CPI(Branch) *IC(Branch).
= (2.56 * 10^9)/(0,7*2)+(1.28*10^9 *12)/(0,7*2)+(256*10^6 *5)
=14.08*10^9cycles

ExecutionTime(2) =Clock Cycle/ Clock Rate = 14.08*10^9cycles/2 * 109cycles/secs
= 7.04 secs

3.1.3 4

ExecutionTime(4):

ClockCycles(4) = CPI(Arithmetic)* IC(Arithmetic)/ 0,7*p + CPI(Load/Store)
*IC (Load/Store) / 0,7*p +CPI(Branch) *IC(Branch).
= (2.56 * 10^9)/(0,7*4)+(1.28*10^9 *12)/(0,7*4)+(256*10^6 *5)
=7.68* 10^9cycles

ExecutionTime(4) =Clock Cycle/ Clock Rate = 7.68*10^9cycles/2 ? 10^9cycles/secs
= 3.84 secs

3.1.4 8

ExecutionTime(8):

ClockCycles(8) = CPI(Arithmetic)* IC(Arithmetic)/ 0,7*p + CPI(Load/Store)
*IC (Load/Store) / 0,7*p +CPI(Branch) *IC(Branch).
= (2.56 * 10^9)/(0,7*8)+(1.28*10^9 *12)/(0,7*8)+(256*10^{+6}*5)
=4.48*10^9cycles
ExecutionTime(8) =Clock Cycle/ Clock Rate = 4.48*109cycles/2 *10^9cycles/secs
= 2.24 secs

3.2 b

ExecutionTme of 1, 2, 4, and 8:

TotalExecutionTime = ExecutionTime(1) + ExecutionTime(2)+ ExecutionTime(4) + ExecutionTime(8)
=9.60secs+7.4secs+ 3.84 secs+ 2.24 secs+ 22.72 secs =22.72 secs.

3.3 c

3.3.1 2

SpeedUp(2)= ExecutionTime(2)/ ExecutionTime(single processor)
=7.04 secs /9.60 secs= 0.73.

3.3.2 4

SpeedUp(4)= ExecutionTime(4)/ ExecutionTime(single processor)
=3.84 secs /9.60 secs= 0.40.

3.3.3 8

SpeedUp(8)= ExecutionTime(8)/ ExecutionTime(single processor)
=2.24 secs /9.60 secs= 0.23.

4 Conclusion

And so on...