1.5: P1: 3 ghz x (1/1.5) = 2 IPS
P2: 2.5 ghz x (1/1.0) = 2.5 IPS
P3: 4 ghz x (1/2.2) = 1.8 IPS
a). Therefore, P2 has the highest Performance in IPS.

b) P1: 3 ghz x 10 s = 30 cycles ∴
30 cycles x 1.5 CPI = 45 instructions
P2: 2.5 ghz x 10 s = 25 cycles
25 cycles x 1.0 CPI = 25 Instructions
P3: 4.0 ghz x 10 s = 40 cycles
40 cycles x 2.2 CPI = 88 Instructions

c) 2.5 ghz x (1/1.2) = 2.08 IPS
Clock Rate = 2.08 IPS / (1/1.2) = 2.5
Clock Rate = 2.5 ghz ∴

1.6:

a) P1: Global CPI = (0.1×1) + (0.2×2) + (0.5×3) + (0.2×3) = 2.3 ∴

P2: Global CPI = (0.1×2) + (0.2×2) + (0.5×2) + (0.2×2) = 2 ∴

b) P1: Clock cycles = 2.3 × 1.0E6 = 2.3E6

P2: Clock cycles = 2 × 1.0E6 = 2E6

1.7:

a) Compiler A:

1.1 s / 1.0E9 instructions = 1.1E-9 s/instruction

2.1E-9 s/I x 1 ns/cycle = 1.1 cycles/instructions

Compiler B:

1.5 s / 1.2E9 I = 1.25E-9 s/I

1.25E-9 s/I x 1 ns/cycle = 1.25 c/s

b) Compiler A:

1.0E9 I / 1.1 s = 9.09E8

1.0E9 I / 9.09E8 I/s = 1.1 s ∴ 73% Faster

Compiler B:

1.2E9 I / 1.5 s = 8.0E8 I/s

1.2E9 I / 8.0E8 I/s = 1.5

c)

New compiler V. compiler A =

6.0E8I / 1.0E9I = 0.6

1.15 / 1.15 = 1

Speedup = 0.6 × 1 = 60% ∴

New compiler V. compiler B =

6.0E8I / 1.2E9I = 0.05

1.15 / 1.55 = 0.73

Speedup = 0.05 × 0.73 = 4% ∴

1.14:

1.14.1: If we want the program to run two times faster, we need to improve the CPI of of FP instructions by a factor of 2

1.14.2: If we want the program to run two times faster, we need to improve the CPI of L/S instructions by a factor of 2

1.14.3: Int: $1 - 0.4 = 0.6$:.

FP: $1 - 0.4 = 0.6$:.

L/S: $4 - 1.2 = 2.8$:., Branch: $2 - 0.6 = 1.4$:.

1.16

a) $1110 = 1\cdot2^3 + 1\cdot2^2 + 1\cdot2^1 + 0\cdot2^0 = 8+4+2+0$
$= 14$ decimal

b) $100100 = 1\cdot2^5 + 0\cdot2^4 + 0\cdot2^3 + 1\cdot2^2 + 0\cdot2^1 + 0\cdot2^0$
$= 32+0+0+4+0+0 = 36$ decimal

c) $11001111 = 1\cdot2^7 + 1\cdot2^6 + 0\cdot2^5 + 0\cdot2^4 + 1\cdot2^3 + 1\cdot2^2 + 1\cdot2^1 + 1\cdot2^0 = 128+64+0+0+8+4+2+1 = 207$ decimal

d) $0111010100100000 = 0\cdot2^{15} + 1\cdot2^{14} + 1\cdot2^{13} + 1\cdot2^{12} + 0\cdot2^{11} + 1\cdot2^{10} + 0\cdot2^9 + 1\cdot2^8 + 0\cdot2^7 + 0\cdot2^6 + 1\cdot2^5 + 0\cdot2^4 + 0\cdot2^3 + 0\cdot2^2 + 0\cdot2^1 + 0\cdot2^0$

$= 0+16384+8192+4096+0+1024+0+256+0+64+0+0+0+0+0+0$
$= 29824$ decimal ∴