(20)

Instruction type	A	B
Cycles per Instruction (CPI)	3	2

PX2000

instructions 45% 55%

new instr 25% 55% = 31-25%, 68-75%

PX3000 → clock cycle time ↓ , CPI' = 1-2 (CPI)

(Q) compiler sol is (1-11)x faster than hardware sol.

PX3000 (clock cycle time) = [???] x of PX2000 (clock cycle time)

Ans → original CPI (PX2000) = (0.45 X 3) + (0.55 X 2)

= 2.45

compiler-optimized

→ A instr = 80% of (45%)

= 0.8 x 45%

= 36%

old Total number of instr = (45%) + 55% = 100%

new Total instr (after optimization) = (36%) + 55% = 91%

→ Old percentages / proportions:

(A) $\frac{45\%}{100\%}$ = 45% , (B) $\frac{55\%}{100\%}$ = 55%

→ New percentages / proportions:

(A) $\frac{36\%}{91\%}$ ≈ 39.56% , (B) $\frac{55\%}{91\%}$ ≈ 60.44%

→ Old CPI:

(0.45 x 3) + (0.55 x 2) = 2.45

→ New CPI:

(0.3956 x 3) + (0.6044 x 2) = 2.3956

→ For PX2000 (compiler Optimized)

Time = inst x CPI x clock time

$= 0.91\ N \times 2.395 \times T$

$= (2.18)(N)(T)$

→ For PX3000 (Hardware optimized)

$CPI_{new} = 2.45 \times 1.2$

$= 2.94$

$Time = N \times 2.94 \times T'$

$= (2.94)(N)(T')$

→ Given: Compiler is 1.11 x faster than hardware solution

$(1.11) \times (2.18)(N)(T) = (2.94)(N)(T')$

$T' = \frac{(1.11)(2.18)}{(2.94)} \cdot T$

$\left(\frac{T'}{T}\right) = 0.82306 \approx 0.8231$

→ For clockspeed ratio,

old : new $= T : T'$

$= \frac{T}{T'}$

$= \frac{1}{\left(\frac{T'}{T}\right)}$

$= \frac{1}{0.8231}$

$= 1.214$

$\boxed{\approx (1.21)}$

→ So, PX3000 is (1.21) x faster than PX2000 in terms of clock cycle time.