(20)

PX2000

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

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)× faster than hardware sol.

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

→ original

$\boxed{\text{Ans}}$ → CPI (PX2000) $= (0·45 \times 3) + (0·55 \times 2)$

$= 2·45$

compiler-optimized

→ A instr $= 80\% \text{ of } (45\%)$

$= 0·8 \times 45\%$

$= 36\%$

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

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

→ Old percentages/proportions:

(A) $\dfrac{45\%}{100\%} = 45\%$; (B) $\dfrac{55\%}{100\%} = 55\%$

→ New percentages/proportions:

(A) $\dfrac{36\%}{91\%} \approx 39·56\%$, (B) $\dfrac{55\%}{91\%} \approx 60·44\%$

→ Old CPI:

$(0·45 \times 3) + (0·55 \times 2) = 2·45$

→ New CPI:

$(0·3956 \times 3) + (0·6044 \times 2) = 2·3456$

→ For PX2000 (compiler Optimized)

Time = instr × CPI × clock time

$= 0.91\ N \times 2.3956 \times T$

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

→ For PX3000 (Hardware optimized)

$CPI_{new} = 2.45 \times 1.2$
$= 2.94$

Time $= N \times 2.44 \times T'$

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

→ Given: Compiler is 1.11× faster than hardware solution

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

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

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

→ For clock speed ratio,

old : new $= T : T'$

$= \dfrac{T}{T'}$

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

$= \dfrac{1}{0.8231}$

$= 1.21491$

≈ 1.2149

≈ 1.215

≈ 1.22

→ So, PX3000 is (1.22)× faster than PX2000 in terms of clock cycle time.