a

Given,

class A : 40% instructions, CPI = 1.5
class B : 35% of instructions, CPI = 2.8
class C : 25% of instructions, CPI = 4.2
clock rate = 3.6 GHz = 3.6×10^9 Hz
Total instructions count = 3 billion = 3×10^9

$\therefore$ Average CPI $= (1.5 \times 40\%) + (2.8 \times 35\%) + (4.2 \times 25\%)$

$= (1.5 \times 0.4) + (2.8 \times 0.35) + (4.2 \times 0.25)$

$= 2.63$ (Ans)

b

$$\text{Execution time (cpu time)} = \frac{\text{Total Instruction count} \times \text{CPI}}{\text{clock rate}}$$

$$= \frac{3 \times 10^9 \times 2.63}{3.6 \times 10^9}$$

$= 2.19$ seconds (Ans)

Question → 2

a

Given,

$T_{affected} = 80\%$ or 0.8

$T_{unaff} = 1 - 0.8$ or 0.2

improvement factor, $n = 4$

$$T_{improved} = \frac{T_{affected}}{n} + T_{unaffected}$$

$$= \frac{0.8}{4} + 0.2$$

$$= 0.4$$

$\therefore$ overall speedup $= \frac{1}{T_{improved}} = \frac{1}{0.4} = 2.5$ (Ans)

b

Given,

$T_{affected} = 20\%$ or 0.2

$T_{unaffected} = 1 - 0.2$ or 0.8

improvement factor, $n = 3$

$\therefore$ $T_{improved} = \frac{T_{affected}}{n} + T_{unaffected}$

$$= \frac{0.2}{3} + 0.8 = 0.8667$$

$\therefore$ overall speedup $= \dfrac{1}{T_{improved}}$

$= \dfrac{1}{0.8667}$

$= 1.153$ (Ans)

Question → 3

Approach a:

$$\text{Execution time}_A\text{(CPU time)} = \frac{I \times CPI}{\text{clock rate}}$$

$$= \frac{I \times 2.2}{4.2 \times 10^9}$$

CPI = 2.2
clock rate $= 4.2 \times 10^9$ Hz

Approach b:

$$\text{Execution time}_B\text{(CPU time)} = \frac{I \times CPI}{\text{clock rate}}$$

$$= \frac{I \times 1.4}{3 \times 10^9}$$

CPI = 1.4
clock rate $= 3 \times 10^9$ Hz

$$\therefore \frac{\text{Execution time}_A}{\text{Execution time}_B} = \frac{\frac{I \times 2.2}{4.2 \times 10^9}}{\frac{I \times 1.4}{3 \times 10^9}} = \frac{\cancel{I} \times 2.2}{4.2 \times \cancel{10^9}} \times \frac{3 \times \cancel{10^9}}{\cancel{I} \times 1.4}$$

$$= \frac{3 \times 2.2}{1.4 \times 4.2} = \frac{55}{49}$$

$= 1.12$

∴ So. Approch b is more effective in reducing than execution time than approach a.

Question - 4

Given,

$C = 3.0$ nF

$V = 1.5$ V

~~fold~~

$f_{initial} = 600$ MHz

$f_{new} = 1$ GHz

$P_{initial} = 0.5$ W

$$\therefore \frac{P_{new}}{P_{initial}} = \frac{C \times V^2 \times f_{new}}{C \times V^2 \times f_{initial}}$$

$$\Rightarrow \frac{P_{new}}{P_{initial}} = \frac{1\text{ GHz}}{600\text{ MHz}}$$

$$\Rightarrow P_{new} = \frac{1000}{600} \times P_{initial}$$

$$= \frac{5}{3} \times 0.5$$

$$= 0.833 \text{ W}$$

Thus, the new power dissipation is approximately 0.833