Date: 12/3/2023 Computer Architecture Solution الاسم:

Quiz #1 الرقم الجامعي:

Q1: A program takes 12 Billion clock cycles to run on a 3 GHz CPU.

a) What is the execution time of the program on this CPU? (2 point)

$$\text{CPU Time} = \frac{\#\text{ of cc's}}{f} = \frac{12 * 10^9}{3 * 10^9} = \boxed{4 \text{ Seconds.}}$$

b) A given compiler generates 9 billion instructions when compiling this program. What is the average CPI? (2 points)

$$CPI = \frac{\#\text{ of cc's}}{IC} = \frac{12 * 10^9}{9 * 10^9} = \boxed{1.33}$$

c) By how much (percentage) do we need to increase the CPU clock rate to reduce the execution time of this program by 15%? (3 points)

$$\text{CPU Time}_{new} = 0.85 * 4 = 3.4 \text{ Seconds}$$

$$3.4 = \frac{12 * 10^9}{f_{new}} \Rightarrow f_{new} = \frac{12 * 10^9}{3.4} = 3.53 \text{ GHz}$$

$$\text{Increase by } \frac{3.53 - 3}{3} = \frac{0.53}{3} = \boxed{17.6\ \%}$$

Q2: Multiplication operations take 30% of the execution time of some program. By how much (percentage) the overall execution time of this program is reduced if the multiplication operation is enhanced to be 3 times faster? (3points)

$$T_{org.} = T$$

$$T_{improved} = \frac{T_{aff.}}{N} + T_{unaff.}$$

$$= \frac{0.3T}{3} + 0.7T$$

$$= 0.1T + 0.7T = 0.8T$$

$$\Rightarrow \boxed{\text{reduced by } 20\ \%}$$