1.

	ALU	load	branch	total
cycles	1	2	4	
A number in millions	30	75	45	150
B number in millions	30	60	30	120
A% occurences	20	50	30	100
B% occurences	25	50	25	100
A CPI				2.4
B CPI				2.25

% Occurences

$$\begin{aligned} total_A &= ALU_A + load_A + branch_A \\ 150 &= 30 + 75 + 45 \\ 1 &= .2 + .5 + .3 \\ 100 &= 20 + 50 + 30 \end{aligned}$$

$$\begin{aligned} total_B &= ALU_B + load_B + branch_B \\ 120 &= 30 + 75 + 45 \\ 1 &= .25 + .5 + .25 \\ 100 &= 25 + 50 + 25 \end{aligned}$$

CPI

$$\text{CPI} = \text{Cycles}_{\text{ALU}}(\text{ALU\%}) + \text{Cycles}_{\text{load}}(\text{load\%}) + \text{Cycles}_{\text{branch}}(\text{branch\%})$$

$$\begin{aligned} \text{CPI}_A &= 1(.2) + 2(.5) + 4(.3) \\ &= .2 + 1 + 1.2 \\ &= 2.4 \end{aligned}$$

$$\begin{aligned} \text{CPI}_B &= 1(.25) + 2(.5) + 4(.25) \\ &= .25 + 1 + 1 \\ &= 2.25 \end{aligned}$$

Execution Time

$$\text{E.T.} = \text{CPI} * \text{Instructions} * \frac{\text{Time}}{\text{Cycle}}$$

$$\begin{aligned}\text{E.T.}_A &= 2.4 * 150,000,000 * \frac{\text{Time}}{\text{Cycle}_A} \\ &= 360,000,000 * \frac{\text{Time}}{\text{Cycle}_A}\end{aligned}$$

$$\begin{aligned}\text{E.T.}_B &= 2.25 * 120,000,000 * \frac{\text{Time}}{1.2 * \text{Cycle}_A} \\ &= \frac{270,000,000}{1.2} * \frac{\text{Time}}{\text{Cycle}_A} \\ &= 225,000,000 * \frac{\text{Time}}{\text{Cycle}_A}\end{aligned}$$

$$\text{E.T.}_B < \text{E.T.}_A$$

2.

	ALU	load	branch	total
cycles	2	4	6	
A number in millions	20	40	30	90
B number in millions	25	50	20	95
A% occurences	$22.\overline{2}$	$44.\overline{4}$	$33.\overline{3}$	100
B% occurences	26	53	21	100
A CPI				$4.\overline{2}$
B CPI				3.9

% Occurences

$$\begin{aligned}total_A &= ALU_A + load_A + branch_A \\ 90 &= 20 + 40 + 30 \\ 1 &= .\overline{2} + .\overline{4} + .\overline{3} \\ 100 &= 22.\overline{2} + 44.\overline{4} + 33.\overline{3}\end{aligned}$$

$$\begin{aligned}total_B &= ALU_B + load_B + branch_B \\ 95 &= 25 + 50 + 20 \\ 1 &= .26 + .53 + .21 \\ 100 &= 25 + 50 + 25\end{aligned}$$

CPI

$$\text{CPI} = \text{Cycles}_{\text{ALU}}(\text{ALU\%}) + \text{Cycles}_{\text{load}}(\text{load\%}) + \text{Cycles}_{\text{branch}}(\text{branch\%})$$

$$\begin{aligned}\text{CPI}_A &= 2(.\overline{2}) + 4(.\overline{4}) + 6(.\overline{3}) \\ &= .\overline{4} + 1.\overline{7} + 1.\overline{9} \\ &= 4.\overline{2}\end{aligned}$$

$$\begin{aligned}\text{CPI}_B &= 2(.26) + 4(.53) + 6(.21) \\ &= .52 + 2.12 + 1.26 \\ &= 3.9\end{aligned}$$

Execution Time

$$\text{E.T.} = \text{CPI} * \text{Instructions} * \frac{\text{Time}}{\text{Cycle}}$$

$$\begin{aligned}\text{E.T.}_A &= 4.\overline{2} * 90,000,000 * \frac{\text{Time}}{1.15 * \text{Cycle}_B} \\ &= \frac{380,000,000}{1.15} * \frac{\text{Time}}{\text{Cycle}_B} \\ &= 330,434,793 * \frac{\text{Time}}{\text{Cycle}_B} \\ \text{E.T.}_B &= 3.9 * 95,000,000 * \frac{\text{Time}}{\text{Cycle}_B} \\ &= 370,500,000 * \frac{\text{Time}}{\text{Cycle}_B}\end{aligned}$$

$$\text{E.T.}_A < \text{E.T.}_B$$

3.

a)

$$\begin{aligned}\text{CPI} &= \frac{\text{price}_A * \text{quantity}_A + \text{price}_B * \text{quantity}_B + \text{price}_C * \text{quantity}_C}{\text{Quantity}_{\text{total}}} \\ &= \frac{100 * 4 + 200 * 4 + 300 * 7}{15} \\ &= 220\end{aligned}$$

b)

$$\begin{aligned} \text{CPI} &= 100 * \frac{3}{12} + 200 * \frac{3}{12} + 300 * \frac{6}{12} \\ &= 225 \end{aligned}$$