CSE331 Homework 1

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A) Wafer Area for Wafer_X $= \pi . (d/2)^2$

$$= (3.14).(16/2)^2$$

$$= (3.14).64$$

$$= 200.96\ cm^2$$

Wafer Area for Wafer_Y $= \pi.(d/2)^2$

$$= (3.14).(20/2)^2$$

$$= (3.14).100$$

$$= 314\ cm^2$$

Die Area for Wafer_X $= \dfrac{\text{wafer area}}{\text{dies per wafer}} = \dfrac{200.96}{64} = 3.14\ cm^2$

Die Area for Wafer_Y $= \dfrac{\text{wafer area}}{\text{dies per wafer}} = \dfrac{314}{100} = 3.14\ cm^2$

B) Yield for Wafer_X $= \dfrac{1}{(1+(dpa . da/2))^2} = \dfrac{1}{(1+(0.02.(3.14)/2))^2} = \dfrac{1}{(1+0.0314)^2}$

$$= 0.94 = \%94$$

Yield for Wafer_Y $= \dfrac{1}{(1+(0.03.(3.14)/2))^2} = \dfrac{1}{(1+0.0471)^2} = 0.912 = \%91.2$

Cost Per Die for Wafer_X $= \dfrac{\text{cost per wafer}}{\text{dies per wafer . yield}} = \dfrac{15}{64.(0.94)} = 0.249$

Cost Per Die for Wafer_Y $= \dfrac{24}{100.(0.912)} = 0.263$

★ dpa : defects per area

★ da : die area

c) **cost per wafer**

$W_x \rightarrow 15 \cdot \frac{80}{100} = \boxed{12}$

$W_y \rightarrow 24 \cdot \frac{80}{100} = \boxed{19.2}$

dies per wafer

$W_x \rightarrow 64 \cdot \frac{110}{100} = \boxed{70.4}$

$W_y \rightarrow 100 \cdot \frac{110}{100} = \boxed{110}$

defects/cm²

$W_x \rightarrow 0.02 \cdot \frac{115}{100} = \boxed{0.023}$

$W_y \rightarrow 0.03 \cdot \frac{115}{100} = \boxed{0.0345}$

	diameter	cost per wafer	dies per wafer	defects/mm²
wafer_X	16cm	15 → 12	64 → 70.4	0.02 → 0.023
wafer_Y	20cm	24 → 19.2	100 → 110	0.03 → 0.0345

wafer area

$W_x = \pi \cdot (d/2)^2 = (3.14) \cdot (16/2)^2 = \boxed{200.96\ cm^2}$

$W_y = \pi \cdot (d/2)^2 = (3.14) \cdot (20/2)^2 = \boxed{314\ cm^2}$

die area

$W_x = \frac{\text{wafer area}}{\text{dies per wafer}} = \frac{200.96}{70.4} \simeq \boxed{2.85\ cm^2}$

$W_y = \frac{\text{wafer area}}{\text{dies per wafer}} = \frac{314}{110} \simeq \boxed{2.85\ cm^2}$

yield

$W_x = \frac{1}{(1+(dpa \cdot da/2))^2} = \frac{1}{(1+((0.023) \cdot (2.85)/2))^2} = \boxed{0.937}$

$W_y = \frac{1}{(1+(dpa \cdot da/2))^2} = \frac{1}{(1+((0.0345) \cdot (2.85)/2))^2} = \boxed{0.908}$

cost per die

$W_x = \frac{\text{cost per wafer}}{\text{dies per wafer} \cdot \text{yield}} = \frac{12}{(70.4) \cdot (0.937)} = \boxed{0.182}$

$W_y = \frac{\text{cost per wafer}}{\text{dies per wafer} \cdot \text{yield}} = \frac{19.2}{(110) \cdot (0.908)} = \boxed{0.192}$

W_x

$0.249 \cdot \frac{x}{100} = 0.182$

$x = 73$

W_y

$0.263 \cdot \frac{y}{100} = 0.192$

$y = 73$

☆ **conclusion**

wafer_x and wafer_y cost per die decreased %27 in a year,

$W_x = 0.249 \rightarrow 0.182$

$W_y = 0.263 \rightarrow 0.192$

2

Clock Rates

$P_1 \rightarrow 3\,GHz$

$P_2 \rightarrow 1.5\,GHz$

Instructions

R type : 300 million

I type : 500 million

J type : 200 million

* $\text{Clock Cycle} = \sum_{i=1}^{n} (CPI_i \times IC)$
* $\text{CPU Time} = IC \times CPI / \text{Clock Rate}$
* $CPI = \dfrac{\text{Clock Cycles}}{\text{Instr. Count}}$

A

Clock cycle for $P_1 \Rightarrow (2\times300)+(4\times500)+(3\times200) = \boxed{3200}$

Clock cycle for $P_2 \Rightarrow (3\times300)+(3\times500)+(3\times200) = \boxed{3000}$

B

Average CPI for $P_1 \Rightarrow \dfrac{3200}{1000} = \boxed{3.2}$

Average CPI for $P_2 \Rightarrow \dfrac{3000}{1000} = \boxed{3}$

C

Execution time for $P_1 \Rightarrow \dfrac{1000 \times 3.2}{3\times10^9} = 1.06\times10^{-6}\,s$

Execution time for $P_2 \Rightarrow \dfrac{1000 \times 3}{1.5\times10^9} = 2\times10^{-6}\,s$

D

$E_1 = 1.06\times10^{-6}\,s = 1.06\,\mu s$

$E_2 = 2\times10^{-6}\,s = 2\,\mu s$

$\dfrac{E_2}{E_1} = \dfrac{2}{1.06} = \boxed{1.88 \text{ times}}$

* P_1 faster than P_2
* P_1 is 1.88 times faster than P_2