CSE331 Homework 1

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1

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

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

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

dies per wafer

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

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

defects/cm²

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

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

	diameter	cost per wafer	dies per wafer	defects/cm²
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,

$W_x = 0.249 \to 0.182$

$W_y = 0.263 \to 0.192$

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

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

A

Clock cycle for $P_1 \Rightarrow (2\times3.10^8)+(4\times5.10^8)+(3\times2.10^8) = \boxed{3.2\times10^9}$

Clock cycle for $P_2 \Rightarrow (3\times3.10^8)+(3\times5.10^8)+(3\times2.10^8) = \boxed{3\times10^9}$

B

Average CPI for $P_1 \Rightarrow \frac{3.2\times10^9}{1\times10^9} = \boxed{3.2}$

Average CPI for $P_2 \Rightarrow \frac{3\times10^9}{1\times10^9} = \boxed{3}$

C

Execution time for $P_1 \Rightarrow \frac{(1\times10^9)\times(3.2)}{3\times10^9\,Hz} = \boxed{1.06s}$

Execution time for $P_2 \Rightarrow \frac{(1\times10^9)\times 3}{1.5\times10^9} = \boxed{2s}$

D

E_1 = Execution Time for P_1 = 1.06s

E_2 = Execution Time for P_2 = 2s

$\frac{E_2}{E_1} = \frac{2}{1.06} =$ 1.88 times

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