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Homework 1

Answers:

1) A) For Wafer_X: Wafer Area $= \pi r^2 = 3.14 \times 8 \times 8 = 200{,}96 cm$

Die Area $= \dfrac{\text{Wafer Area}}{\text{Dies Per wafer}} = \dfrac{200{,}96 cm}{64} = 3{,}14 cm$

For Wafer_Y:

Wafer Area $= \pi r^2 = 3{,}14 \times 10 \times 10 = 314 cm$

Die Area $= \dfrac{\text{wafer Area}}{\text{Dies Per wafer}} = \dfrac{314}{100} = 3{,}14 cm$

B) For wafer_X: $\text{yield} = \dfrac{1}{(1+(\text{Defects Per area} \times \text{Die Area}/2))^2}$

$= \dfrac{1}{(1+(0{,}02 \times \frac{3{,}14}{2}))^2} = \dfrac{1}{(1+(0{,}02 \times 1{,}57))^2}$

$= 0{,}940$

$\text{cost per die} = \dfrac{\text{cost per wafer}}{\text{Dies Per wafer} \times \text{yield}} = \dfrac{15}{64 \times 0{,}940}$

$= \dfrac{15}{60{,}16} = 0{,}249$

For wafer_Y: $\text{yield} = \dfrac{1}{(1+(\text{Defects Per Area} \times \text{Die Area}/2))^2}$

$= \dfrac{1}{(1+(0{,}03 \times 1{,}57))^2} = \dfrac{1}{(1+(0{,}047))^2} = 0{,}912$

$\text{cost per die} = \dfrac{\text{cost per wafer}}{\text{Dies Per wafer} \times \text{yield}} = \dfrac{24}{100 \times 0{,}912}$

$= \dfrac{24}{91{,}2} = 0{,}263$

c)

New Table Value	diameter	cost per wafer	Dies Per wafer	Defects Per Area
wafer_X	16cm	12	70,4	0,023cm
wafer_Y	20cm	19,2	110	0,0345cm

For wafer_X: wafer Area $= \pi r^2 = 3{,}14 \times 8 \times 8 = 200{,}96cm$

$$\text{Die Area} = \frac{\text{wafer Area}}{\text{Dies Per wafer}} = \frac{200{,}96cm}{70{,}40} = 2{,}85cm$$

$$\text{Yield} = \frac{1}{(1+(\text{Defects Per Area} \times \text{Die Area}/2))^2}$$

$$= \frac{1}{(1+(0{,}023 \times \frac{2{,}85}{2}))^2} = \frac{1}{(1+0{,}032)^2}$$

$$= \frac{1}{1{,}065} = 0{,}938$$

$$\text{cost per die} = \frac{\text{cost per wafer}}{\text{Dies Per wafer} \times \text{Yield}} = \frac{12}{70{,}4 \times 0{,}938}$$

$$= \frac{12}{66{,}04} = 0{,}182$$

For wafer_Y: wafer Area $= \pi r^2 = 3{,}14 \times 10 \times 10 = 314cm$

$$\text{Die Area} = \frac{\text{wafer Area}}{\text{Dies Per wafer}} = \frac{314}{110} = 2{,}85cm$$

$$\text{Yield} = \frac{1}{(1+(\text{Defects Per Area} \times \text{Die Area}/2))^2}$$

$$= \frac{1}{(1+(0{,}0345 \times \frac{2{,}85}{2}))^2} = \frac{1}{(1+0{,}0491)^2}$$

$$= \frac{1}{1{,}100} = 0{,}909$$

$$\text{cost per die} = \frac{\text{cost per wafer}}{\text{Dies Per wafer} \times \text{Yield}} = \frac{19{,}2}{110 \times 0{,}909}$$

$$= \frac{19{,}2}{99{,}99} = 0{,}192$$

Both wafer_X's and wafer_Y's cost per die is 1,369 times less than previous year.

2) R Type Instructions $= 3\times10^8$

P_1 – L Type Instructions $= 5\times10^8$

J Type Instructions $= 2\times10^8$

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A) $P_1 = 2\times3\times10^8 + 5\times10^8\times4 + 2\times10^8\times3 = 3{,}2\times10^9$ clock cycles

$P_2 = 3\times3\times10^8 + 5\times10^8\times3 + 2\times10^8\times3 = 3{,}0\times10^9$

B) $P_1 = \frac{3{,}2\times10^9}{1\times10^9} = 3{,}2 \rightarrow$ Average CPI

$P_2 = \frac{3.0\times10^9}{1\times10^9} = 3$

c) Execution time for P_1 : $\frac{\text{Instruction count} \times \text{CPI}}{\text{clock Rate}}$

$= \frac{\cancel{1\times10^9}\times3{,}2}{3\times\cancel{10^9}} = \frac{3{,}2}{3} = 1{,}066$ sec

Execution time for P_2 : $\frac{\text{Instruction count} \times \text{CPI}}{\text{clock Rate}}$

$= \frac{\cancel{1\times10^9}\times3}{1{,}5\times\cancel{10^9}} = 2$ sec

D) P_1 is $\frac{2}{1{,}066} = 1{,}875$ times faster than P_2.

or

$$\frac{Ex_{P1}}{Ex_{P2}} = \frac{3{,}2\times\cancel{I}\times\frac{1}{2\text{ GHz}}}{3\times\cancel{I}\times\frac{1}{1{,}8\text{ GHz}}} = \frac{1{,}6}{3} = 0{,}533$$